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REPORT

of the

Army Field Forces

Board No. 3

FORT BENNING, GEORGIA

VOLUME 1 OF 2 VOLUMES

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Project No. 2231

REPORT OF JOINT TEST OF UNITED STATES AND UNITED KINGDOM
LIGHTWEIGHT RIFLES AND AMMUNITION THEREFOR
INCLUDING IMPLEMENTING ACTION BY A.F.F. BOARD NO. 3

Date 27 October 1950

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OFFICE, CHIEF OF ARMY FIELD FORCES
Fort Monroe, Virginia

ATDEV-11 474/31(C)(14 Dec 50) 14 December 1950

SUBJECT: Report of Army Field Forces Board No 3 Project No 2231, "Report of Joint Test of United States and United Kingdom Lightweight Rifles"

TO: Assistant Chief of Staff, G-4, Logistics
Department of the Army
Washington 25, DC
ATTN: Research and Development Division

1. Inclosed is report of Army Field Forces Board No 3 Project No 2231, 27 October 1950, subject: "Report of Joint Test of United States and United Kingdom Lightweight Rifles."

2. The tests revealed that none of the items is suitable or acceptable to the United Kingdom or United States. The United States needs no interim rifle to replace the M-1. For long range development military characteristics for a new rifle for the United States will be altered to facilitate obtaining a satisfactory lightweight rifle and ammunition as prescribed in Army Equipment Board Report, 1950. No round will be considered as satisfactory for United States use unless it is at least equivalent in shocking or wounding power to the combat round employed by our potential enemy.

3. The recommendations contained in paragraph 6 of Army Field Forces Board No 3's report are disapproved.

4. Reference the joint recommendations, page 79 of the inclosed report:

a. The caliber for lightweight rifles and machine guns should be selected to provide muzzle energy comparable to that of the M-2 ammunition.

b. For urgent interim requirements consideration should be given to using the M-1 rifle and its current ammunition.

5. The joint recommendations contained in paragraph 8 of the report are not concurred in.

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ARMY FIELD FORCES BOARD NO. 3
Fort Benning, Georgia.

GNBCG 474 27 October 1950

SUBJECT: Report of Test of Project No. 2231

TO: Chief,
Army Field Forces
Fort Monroe, Virginia.

1. Reference:

a. 1st Indorsement ATDEV-11 474 (c) (19 October 1949) 20 April 1950, Office, Chief, Army Field Forces, Fort Monroe, Virginia, to President of Army Field Forces Board No. 3, Fort Benning, Georgia, to Letter, Department of the Army, General Staff, United States Army, Washington 25, D. C., 19 October 1949, GSGLD/F 51117, "Comparative Test of Light Rifles and Ammunition," to Chief of Army Field Forces, Fort Monroe, Virginia, ATTN: Development Section.

b. Report of Test of Project No. 2231 - Report of Joint Test of United States and United Kingdom, Lightweight Rifles.

2. Purpose: To determine the suitability of any of the test items, rifles or ammunition, for Army Field Forces use.

3. a. In compliance with reference 1st Indorsement, the following items were jointly tested at Fort Benning by Army Field Forces Board No. 3 and U. K. personnel:

British Ammunition Caliber .280
U. S. Ammunition T-65, Caliber .30
British Rifle EM-2, Caliber .280
British Rifle FN, Caliber .280
U. S. Rifle T-25, Caliber .30

b. The British measurements of caliber are between the grooves and the U. S. measurements are between the lands. British caliber .280 is equivalent to U. S. caliber .276.

4. Results of test are as shown in the inclosed report of the Joint U. S. - U. K. Board, reference 1b.

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5. Army Field Forces Board No. 3 Concludes:

a. That military characteristics for light rifles and ammunition require revision in order:

(1) To permit compromise in design to produce the optimum performance.

(2) To set standards which can be achieved for interim use.

b. That the U. S. T-65 Cal. .30 round is not suitable for Army Field Forces use because of its excessive recoil, blast, flash and smoke.

c. That the British Cal. .280 round is not suitable for Army Field Forces use because of its comparatively high trajectory.

d. That of the two basic type rounds submitted for test, the British caliber .280 round is preferred.

e. That none of the test rifles are suitable for Army Field Forces use in their present form.

f. That of the rifles tested, the British FN shows the most promise of development for early use.

6. Recommendations:

a. That appropriate paragraphs of the military characteristics for rifles (Army Field Forces Board No. 3 Report of Project No. 2227), and for small arms ammunition (Army Field Forces Board No. 3 Report of Project No. 2256) be modified for interim use to include the provisions of inclosures 2 and 3.

b. That development of small arms ammunition, lightweight rifles and machine guns be carried out in U. S. .276 caliber (British .280 caliber).

Burton L. Lucas

BURTON L. LUCAS
Colonel, Infantry
President.

5 Incls.
1. Coordination
2. Minority Rpt.
3. Proposed Amdts to MC for Small Arms Ammunition for Interim Use.
4. Proposed Amdts to MC for a Lightweight Rifle for Interim Use.
5. Rpt. of Joint Test

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COORDINATION
PROJECT NO. 2231
TEST OF LIGHTWEIGHT RIFLE AND AMMUNITION THEREFOR

1. Army Field Forces Board No. 3 proposed Board Action together with the joint Report of Test of Lightweight Rifle and Ammunition therefor was sent to the following agencies for concurrence or comment:

a. The Infantry School

b. The Artillery School

c. The Armored School

d. The Airborne Center

e. Army Field Forces Board No. 1

f. Army Field Forces Board No. 2

g. Army Field Forces Board No. 4

h. The Engineer Research and Development Laboratories (Office, Chief of Engineers was also represented)

i. The Marine Corps Board (Through Liaison Officer, AFF Board #3)

2. A coordination conference was held at Fort Benning on 16 - 17 October 1950 at which all agencies listed in paragraph 1. above were represented, except Army Field Forces Board No. 4 and the Marine Corps Board. (The Marine Corps Liaison Officer with Army Field Forces Board No. 3 was present.) A firing demonstration was given after which all representatives fired each type of test rifle. The tests were explained and discussion was invited. At the conclusion of the conference written concurrences and/or comments were submitted by the representatives present. The concurrences and/or comments of the representatives, who were authorized to submit tentative ones only, were confirmed by T.W.X. after the representatives returned to their home station and discussed the report with their agencies.

3. No comments have been received from the Marine Corps Board or Army Field Forces Board No. 4.

4. The following agencies concurred without comment:

a. The Infantry School

b. The Armored School

c. The Airborne School

d. Army Field Forces Board No. 2.

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5. The following agencies concurred with comments as indicated:

a. Army Field Forces Board No. 1:

(1) " 1. Army Field Forces Board No. 1 concurs in the Conclusions and Recommendations, Project No. 2231, Army Field Forces Board No. 3, except paragraphs 5d and 6b.

" 2. Army Field Forces Board No. 1 has no comments to offer on paragraphs 5d and 6b."

(2) Comments: These two paragraphs read:

" 5d - That of the two basic type rounds submitted for test, the British caliber .280 is preferred."

" 6b - That the development of small arms ammunition, lightweight rifle and machine guns be carried out in the U. S. - .276 caliber (British .280 caliber).

The comments do not include a substitute recommendation of caliber or a concurrence with the minority report that caliber be determined to meet performance requirements.

b. Office, Chief of Engineers:

(1) " 1. The Office, Chief of Engineers, concurs in the Conclusions of paragraph 5 and the Recommendations of paragraph 6 of the Basic letter.

" 2. However, it is desired that this concurrence be considered as an interim concurrence to assist in further development of small arms and ammunition and not as a final approval of the British rifle, type FN, and the caliber .280 round in their present state of development."

(2) Comment: The Conclusions and Recommendations submitted by this Board were intended to expedite development.

c. The Engineer Research and Development Laboratories:

(1) " 1. The Laboratories favor the retention of the present M-1 Rifle and its standardization by the U. S., U. K., and Canada until a substantially improved weapon is developed.

" 2. It is considered that the present line of development shows promise of resulting in such a weapon.

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" 3. The Laboratories, therefore:

" a. Concur in the Conclusions and Recommendations of the Subject Report.

" b. Concur in proposed Ammendments to Military Characteristics for a Lightweight Rifle for Interim Use.

" c. Concur in proposed Ammendments to Military Characteristics for Small Arms Ammunition for Interim Use."

(2) Comments: NONE.

d. The Artillery School:

(1) " 1. The opinions of Representative of the Artillery School are as follows:

" a. The Report of Test of Project 2231, Army Field Forces Board No. 3, 5 October 1950, is concurred in except the Minority Report inclosed therewith which is not concurred in.

" b. Changes to Appendix E "Deficiencies and Suggested Modifications" are recommended as follows, with reference to the FN rifle, caliber .280:

" (1) Sub-paragraph 2c under "Result", add "Sloping part of stock bruises firer". Under "Suggested Modification", add "Design stock so that all firers can rest cheek against horizontal part of stock."

Comment: It was felt that lengthening the stock one inch would accomplish desired results. (One stock was lengthened and checked and found in brief check to be satisfactory).

" (2) Add 2 a (Deficiency) Receiver is longer than that of the M-1 and T-25 rifles. (Result) Stock and barrel have been shortened to obtain overall length of 35 3/4 inches (Suggested Modification) Reduce length of receiver".

Comment: This is a problem of redesign of the weapon and would require major modifications. It is felt that the receiver could possibly be shortened for the present .280 cartridge; this

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might be accomplished by the designer when a round of ammunition is agreed on.

" (3) Add 2 t (Deficiency) Barrel is too short. (Result) Muzzle velocity is reduced to about 150 feet per second less (estimated) than that of EM-2, and consequently, range, striking power, etc. are reduced. (Suggested Modification) Increase the length of the barrel as much as possible without sacrifice of other important desirable characteristics."

Comment: The Board does not agree that the lengthening of the rifle barrel is a necessity; however, a longer barrel will be acceptable if desired performance cannot be accomplished by other means.

" (4) Add 2a (Deficiency) Bayonet has no handle. (Result) Bayonet is not suitable for use as a hand weapon. (Suggested Modification) Produce a knife-type bayonet similar to those designed for T-25 and EM-2 rifles".

Comment: It is believed that the design of the bayonet should be considered separately from the rifle and that this design should be in accordance with previously established requirement for a knife type bayonet.

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MINORITY REPORT
TO
REPORT OF TEST OF PROJECT NO. 2231

1. The following members of Army Field Forces Board No. 3 non-concur in the recommendation that development of small arms ammunition, lightweight rifles and machine guns be carried out in U. S. .276 caliber (British .280 caliber).

2. These officers take the position that military characteristics should establish the performance required and that the caliber to meet the required performance should be based on the recommendation of the designer.

3. There is no objection to a caliber .280 as such, and it appears to offer advantages in reduced weight and bulk. However, the caliber selected should be that which will best provide the performance outlined in Inclosures No. 3 and No. 4.

(While it was considered inappropriate to submit a minority report on the joint conference, these three officers took the same position during that conference.)

Burton L. Lucas.
BURTON L. LUCAS
Colonel, Infantry

C. W. Pence
C. W. PENCE
Colonel, Infantry

Edward A. Chaal
EDWARD A. CHAAL
Colonel, Infantry

INCLOSURE NO. 2

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PROPOSED AMMENDMENTS TO MILITARY CHARACTERISTICS FOR

SMALL ARMS AMMUNITION FOR INTERIM USE

(Army Field Forces Board No. 3 Report of Project #2256)

1. Flash and Smoke: It is desirable that the small arms round produce neither flash nor smoke. Of the two, the suppression of smoke is the more desirable.

2. Maximum Ordinate: For a range of 600 yards, the maximum ordinate of the round produced shall not exceed four feet.

3. Penetration: The round shall be capable of penetrating helmets at ranges up to 1000 yards and cause an incapacitating wound. It shall be capable of penetrating 36 inches of pine boards at 100 yards. It shall produce an incapacitating wound in personnel protected by only uniforms and equipment at ranges up to 2000 yards.

4. Accuracy: The mean radius of the ammunition when fired from a Mann barrel at 600 yards shall not exceed seven inches.

5. Recoil: The recoil caused by the ammunition shall be the minimum possible commensurate with the other characteristics.

6. Size and Weight: The size and weight of the round produced shall be held to a minimum. However, performance shall not be sacrificed.

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INCLOSURE NO. 3

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PROPOSED AMMENDMENTS TO MILITARY CHARACTERISTICS FOR

A LIGHTWEIGHT RIFLE FOR INTERIM USE

(Army Field Forces Board No. 3 Report of Project #2227)

1. Semi-automatic Accuracy: The semi-automatic accuracy of the lightweight rifle combined with its combat ammunition shall not be less than the U. S. M-1 rifle firing M-2 ball cartridges at 600 yards.

2. Reliability: The mechanical reliability of the rifle shall be comparable to the BAR or the Bren under all conditions of combat.

3. Weight: The rifle shall be as light as possible without sacrificing other characteristics. Its basic weight shall not exceed 8.5 pounds. The magazine shall be as light as possible without compromising reliability and durability and shall not exceed .5 pounds.

4. Sustained Fire: The rifle shall be capable of maintaining rates of fire of 15 rounds per minute for 30 minutes and 40 rounds per minute for 5 minutes without so overheating as to cause damage to the rifle or undue discomfort to the firer. These rates apply to both automatic and semi-automatic fire.

5. Automatic Accuracy:

a. With Rest (muzzle and elbow): All shots in a ten round group fired in bursts of two and three rounds shall strike within a 40' circle at 200 yards.

b. Without rest (standing): 75% of the rounds of any burst shall strike within a 40" circle at 50 yards.

6. Hard Usage, Abnormal Conditions: The rifle shall be capable of functioning in rain, dust, mud, snow and if possible, at low temperature without the use of a special lubricant and special accessories.

7. Combat Magageability: Under all conditions of combat and in varied firing positions encountered in combat, the rifle shall be easy to control and fire. It shall be easy to carry at the ready or through brush.

8. Effect on Firers: The rifle with its ammunition shall have the minimum adverse effect (kick,blast,etc.) on firers and adjacent personnel.

9. Attachments: The necessary attachments (grenade launcher,bayonet, etc.) shall not cause a change in the center of impact when attached of more than 12 inches at 300 yards.

10. Sights: The sights shall be considered separately from the rifles and shall include: range graduations in 100 yard increments to 800 yards, intermediate adjustments are desirable; lateral adjustment is desirable in plainly marked graduations. The sight shall be provided with a battle sight adjustment. The sight shall be rugged and durable enough to withstand the same hard usage as the rifle.

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REPORT

of the

Army Field Forces

Board No. 3

FORT BENNING, GEORGIA

Project No. 2231

REPORT OF JOINT TEST OF UNITED STATES AND UNITED KINGDOM

LIGHTWEIGHT RIFLES
AND AMMUNITION THEREFOR

Date 27 October 1950

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ARMY FIELD FORCES BOARD NO. 3
Fort Benning, Georgia

REPORT OF TEST OF PROJECT NO. 2231

REPORT OF JOINT TEST OF UNITED STATES AND UNITED KINGDOM

LIGHTWEIGHT RIFLES

1. Authority:

a. 1st Indorsement ATDEV-11 474 (c) (19 October 1949) 20 April 1950, Office, Chief, Army Field Forces, Fort Monroe, Virginia, to President of Army Field Forces Board No. 3, Fort Benning, Georgia, to Letter, Department of the Army, General Staff, United States Army, Washington 25, D. C., 19 October 1949, GSGLD/F 51117, "Comparative Test of Light Rifles and Ammunition," to Chief of Army Field Forces, Fort Monroe, Virginia, ATTN: Development Section.

b. Purpose: To determine the comparative suitability of the test rifles and their ammunition for use by the countries participating in the test.

2. References:

a. Military characteristics for a Lightweight Rifle, Project 2227, AFF Board No. 3, 29 June 1949, as changed by letter, Headquarters AFF, Fort Monroe, Virginia, ATDEV-11 400.114/7(c) (25 August 1949) to Director of Logistics, General Staff, U. S. Army, Washington 25, D. C., ATTN: Research and Development Group. (Secret)

b. "Military Characteristics for Small Arms Ammunition", Project No. 2256, AFF Board No. 3, as changed by letter Headquarters, AFF, Fort Monroe, Virginia, ATDEV-11 471/86(c) (20 July 1950), "Military Characteristics of Small Arms Ammunition," to Assistant Chief of Staff, G-4, Logistics, General Staff, U. S. Army, Washington 25, D. C., ATTN: Research and Development Division. (Secret).

c. Report of Army Equipment Board 1950. (Secret)

d. British War Office Policy Statement No. 9 dated 31 October 49 (Revised 30 November 49), Armament of the Infantry (Part II, Paragraphs 11, 12, 13, 20, 21 and 22, Appendix "B", Specifications for a new Automatic Rifle, Appendix "M", Specification for a New Small Arms Ammunition). (Secret).

e. Report of AFF Board No. 3, Fort Benning, Georgia, "Rifle Lightweight caliber .30 T-25", 6 May 1949, Project No. 2184.

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f. Agreement on Comparative Tests of Light Rifles and Ammunition, 18 October 1949. (Confidential).

g. British Armaments Design Department Technical Report No. 5/47 "The Choice of a Standard Round for Small Arms", March 1947. (Secret).

h. Aberdeen Proving Ground Report Project T52-2015 "A Comparison Test of United Kingdom and United States Lightweight Rifles".

i. Aberdeen Proving Ground Report Project T52-2015 "A Comparison Test of United Kingdom and United States Ammunition for Lightweight Rifles". Volumes I and II.

j. Medical Division Research Report No. 19 " ound Balistics of .280 caliber U.K. and .30 caliber U. S. Bullets" Chemical Corps, Army Chemical Center, Maryland, September 1950.

3. Description of Material:

a. Three types rifles to fulfill the requirements for a lightweight rifle as established by references a and c above were presented for test. The U. S. Ordnance fabricated one .30 caliber rifle, the T-25. The British Armament Design Establishment of the Ministry of Supply fabricated at Enfield one rifle, the EM-2; and contracted for one to be fabricated at Fabrique National, Liege, Belgium, the FN. Both rifles are .280 caliber. These rifles hereafter will be referred to by their short titles, T-25, EM-2 and FN.

b. Standard weapons of the United Kingdom and United States were modified to accept the newly developed rounds of ammunition.

c. A brief description of these rifles follows: (For details - see Appendix "B" and Appendix "C", T-1).

(1) The T-25 weighs 7.9 pounds and is 43 inches long. This rifle is equipped with a straight line stock and stabilizer designed to prevent climbing in automatic fire. It is gas operated and capable of selective semi-automatic or automatic fire. It is loaded by a 20 round magazine from the bottom. It is equipped with a bayonet, grenade launcher and bipod.

(2) The EM-2 weighs 8.05 pounds and is 35 inches long. This reduced length is possible without reducing barrel length because the recoil mechanism is inclosed in the stock. It is gas operated and capable of selective semi-automatic or automatic fire. It is loaded by a 20 round magazine from the bottom. It is equipped with a bayonet, grenade launcher and bipod.

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(3) The FN weighs 8.55 pounds and is 39 inches long. The reduction in length is accomplished by using a barrel length of 19½ inches and a very short stock. It is gas operated and capable of selective semi-automatic or automatic fire. It is loaded by a 20 round magazine from the bottom. It is equipped with bayonet, grenade launcher, bipod, flash-hider and recoil check.

d. Ammunition provided for the test rifles included Ball (mild steel cored) API, Tracer, AP, and observing rounds.

(1) For EM-2 and FN: The characteristics of the .280 ball cartridge are: length 2.53 inches, weight .046 pounds, weight of bullet 140 Grs., powder charge 31 Grs., velocity at 78 feet: 2271 ft/sec.

(2) For T-25: The characteristics of the .30 caliber ball (T-104) are: length 2.785", weight .052 lbs, weight of bullet 137.1 Grs, powder charge 47 Grs, velocity at 78 feet: 2771 ft/sec.

c. The U. S. M-1 rifle with standard ammunition was used as a control item in this test.

4. Background:

a. The British requirement for a lightweight selective Semi-automatic or Automatic rifle weighing approximately eight pounds was established by British War Office Policy Statement No. 9, Part II, paragraphs 11, 12 and 13. Appendix "B" to the above Policy Statement established the British characteristics to meet the requirement established by Policy Statement No. 9.

b. The U. S. requirement for a lightweight rifle was initially established by the War Department Equipment Board Report in 1946. This requirement was reiterated by Army Equipment Board Report of 1950. The military characteristics to meet this requirement were outlined in Military Characteristics for a Lightweight Rifle, Project 2227, AFF Board No. 3, 29 June 1949.

c. Both the above requirements and military characteristics envisaged a change in small arms ammunition. Military characteristics for the ammunition were set forth by the British War Office in Appendix "M" to Policy Statement No. 9 and by the U. S. in Military Characteristics for Small Arms Ammunition, Project 2256, AFF Board No. 3.

d. The British War Office conducted an extensive study on calibers in order to determine the ideal caliber for small arms. The report of study stated that .276 was the ideal caliber. However, development was carried out in .280 caliber because of the additional bullet volume required for API ammunition. The U. S. requirement for a lightweight rifle stated that a .30 caliber rifle should be developed.

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e. With a view to joint standardization of small arms and ammunition, initial meetings of personnel responsible for development first took place in Washington, D. C. in the summer of 1947.

f. From these initial meetings an agreement was reached for each government to develop rifles from its established military characteristics and present these weapons for joint test. The British were to develop rifles in .280 caliber and the U. S. in .30 caliber.

g. The U. S. developed the T-25 rifle which was given a preliminary test at Fort Benning from February to April, 1949. This test is covered in AFF Board No. 3 Report No. 2184, 6 May 1949.

h. In October 1949 a joint meeting, including both user and technical personnel, met in Washington, D. C., and agreed upon a plan of test for the rifles. The meeting also agreed that standard weapons of both countries would be converted to fire the new ammunition and would be fired at Fort Benning to demonstrate the feasibility of conversion. These tests were to be conducted in the United States. The time for the technical tests to start at Aberdeen Proving Ground was set for 1 February 1950, to be followed by user tests at Fort Benning, Georgia. The Fort Benning phase of the test started 3 May 1950. In addition to the tests a study on the wound balistics of the .280 caliber United Kingdom and the .30 caliber U. S. bullets was made during the summer of 1950 at the Army Chemical Center, Maryland. The results of this study are found in reference 2 j, above.

i. The U.K.-U.S. agreed plan of test (paragraph 4 g, above) envisaged the testing of the rifles and ammunition without the imposition of a time limit. It became necessary to submit the report of test by 1 November 1950 due to the expected convening of the Joint Infantry Airborne conference scheduled for 15 November 1950. The shortened time available for testing necessitated the modification of the methods layed down in the agreed Plan of Test. However, all modifications were jointly agreed upon by the U.K. user representatives and the U. S. user representatives and the methods used are stated in each test.

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5. SUMMARY OF TESTS:

a. Test No. 1:

(1) Purpose: To determine the physical characteristics of the test rifles.

(2) Method:

Rifles and accessories were weighed and measured locally. Where complete data could not be obtained with equipment available, results of the Light Rifle Test, Aberdeen Proving Ground, Maryland, were used.

(3) Results:

See Appendix "B".

b. Test No. 2:

(1) Purpose: To determine that part of the combat load attributable solely to the tested rifle, accessories and ammunition imposed on the individual soldier.

(2) Method:

(a) All test rifles, the U. S. M-1 rifle and the British No. 4 rifle were assembled together with sling, bayonet and scabbard, and where applicable, grenade launcher and bipod, and weighed.

(b) To these weights were added the weights of 200 rounds of the appropriate ammunition, and where applicable, 10 magazines.

(3) Results:

(a) The items with their weights as described in paragraph 2a and b, above, are as follows:

Weights in Pounds

Items	M-1	No. 4	T-25	EM-2	FN
Weight of Rifle and Sling	10.23	9.25	8.38	8.53	9.07
Bayonet and Scabbard	1.24	1.00	.90	1.12	1.00
Total	11.47	10.25	9.28	9.65	10.07
Bipod	- -	- -	.80	.70	.57
Grenade Launcher	.63	- -	*.33	.66	.65

* Sight not included.

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Weights in Pounds (Cont'd)

Items	M-1	No. 4	T-25	EM-2	FN
Total	12.10		10.41	11.01	11.29
200 Rounds Ammunition	11.36		10.38	9.10	9.10
Total	23.46		20.79	20.11	20.39
Clips or 10 Empty Magazines	2.18		6.20	5.40	4.88
Total	25.64		26.99	25.51	25.27

Figure No. 1

(4) Analysis:

(a) The three test rifles with attachments of bayonet, scabbard and sling are all lighter than the U. S. rifle M-1 and the British rifle No. 4; the T-25 (9.28 lbs) being the lightest and the FN (10.07 lbs) the heaviest.

(b) The British rifle No. 4 being a bolt action rifle is not suitable for further comparison with any of the test rifles.

(c) Compared with the M-1 with accessories and 200 rounds of ammunition in clips, the EM-2 and FN with accessories and 200 rounds of ammunition in magazines are both slightly lighter, while the T-25 under the same condition is slightly heavier. The weights of the rifles with accessories and 200 rounds of ammunition are: M-1 25.64 lbs, FN 25.27 lbs, EM-2 25.51 lbs and T-25 26.99 lbs.

(d) While the T-25 with normal attachments is lighter than the EM-2 and FN (paragraph (a), above) the addition of 200 rounds in magazines makes it the heaviest of the three rifles (paragraph (c), above). This is due to the heavier caliber .30 ammunition and T-25 magazine. The weights of 200 rounds in magazines are: T-104 (T-25) 16.58 lbs, .280 (EM-2) 14.50 lbs, .280 (FN) 13.98 lbs, (200 rounds caliber .30 ammunition in clips (M-1) 13.54 lbs.) (Appendix "C", T-2)

c. Test No. 3:

(1) Purpose: To determine the comparative ease of assembly and disassembly and difficulty of training therein, of the tested rifles.

(2) Method:

(a) The U. S. M-1 rifle was used as a control item.

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(b) One squad consisting of six U. S. and six Canadian enlisted men were given instruction in the assembly and disassembly of each of the four weapons. Observations were made as to difficulty in training for each weapon. The test personnel then were required to perform two types of assembly and disassembly with each weapon: (1) Field stripping and (2) Complete disassembly for maintenance purposes. Each individual made three trials with each type weapon. Time required was noted in each instance.

(3) Results:

(a) The averages of three trials by the test personnel are shown in chart below:

EASE OF ASSEMBLY AND DISASSEMBLY

TIME IN SECONDS

	Field Stripping	Assembly after Field Stripping	Maintenance Stripping	Assembly after Maintenance Stripping
EM-2	74	195	116	179
FN	47	67	46	75
M-1	59	130	61	142
T-25	107	262	156	359

Figure No. 2

(b) No special tool is required to field strip the FN and EM-2, while the T-25 requires a combination tool.

(4) Analysis:

By far the simplest of the rifles in assembly, disassembly and training therein is the FN. The remaining rifles in order are the M-1, the EM-2, and the T-25. The T-25 is the most difficult by far of the rifles tested and is unsatisfactory because it is undesirably difficult. (Appendix "C",T-3)

d. Test No. 4:

(1) Purpose: To determine the ease of care and cleaning and the equipment required for field maintenance.

(2) Method:

(a) During all tests a record was kept of the ease of cleaning of all rifles by test personnel. The diffi-

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culties encountered, and the tools and accessories required, were noted. The U. S. M-1 rifle was used as a control item.

(b) Time required to strip and assemble for field maintenance was reported on in Test No. 3.

(3) Results:

(a) No major difficulties were encountered in cleaning test rifles other than the difficulty of stripping and assembling the T-25. The following difficulties peculiar to each rifle were noted:

1. EM-2 Rifle: Carbon and metallic fouling built up in the gas cylinder requiring a special wire brush for removal.

2. FN Rifle: Carbon and metallic fouling built up in gas regulator, requiring a reamer for its removal.

3. T-25 Rifle: Piston filled with carbon and metallic fouling. The two sizes of the interior of the piston require two sizes of reamers, or one tool combining two reamers of the proper size.

(b) No special items of equipment were required for field maintenance of the test rifles except as listed below:

1. EM-2: Combination tool, including wire brush for cleaning gas cylinder.

2. FN: Cleaning rod (rigid type) with brush for gas cylinder. Combination tool and reamer for gas regulator.

3. T-25: Combination tool with two stage reamer (or two reamers) for piston, and chamber brush.

4. M-1: Combination tool with chamber brush.

(c) No cleaning kits were provided with test rifles.

(d) There is no place in test rifles to carry cleaning kit.

(e) Issue type oil was satisfactory for all weapons.

(f) The average times required to field strip, carry out field maintenance, and then reassemble the rifles are

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as listed below:

EM-2	-	19 minutes 24 seconds
FN	-	17 minutes 11 seconds
M-1	-	18 minutes 9 seconds
T-25	-	21 minutes 9 seconds

(4) Analysis:

(a) The FN and the EM-2 are satisfactory from the point of view of the ease of field maintenance. The T-25 is not satisfactory because it is undesirably complicated. The order of acceptability is FN, EM-2 and T-25.

(b) A special spare parts and cleaning kit is required for all test rifles. (Appendix "C", T-4).

c. Test No. 5:

(1) Purpose: To determine the stability, durability and suitability of sights and whether or not sights have a battle sight adjustment.

(2) Method:

Throughout all firing tests the functioning and use of sights was observed and sights were inspected periodically for damage or malfunction. Data obtained in Test No. 17½ (Hard Usage) was studied. Sights were tested under various conditions of visibility.

(3) Results:

(a) None of the sights were difficult to read, adjust or set. The optical sight of the EM-2 was the easiest, having no adjustments to be made by the firer, and the T-25 was the most difficult. None had a battle sight adjustment.

(b) In hard usage tests (Test No. 17½) no damage was done to any of the sights. However, the T-25 sight caught in brush, as did the EM-2 sight to a lesser degree; and the FN sight changed setting.

(c) Periodic inspections during all firing tests showed the following defects: In the T-25, play developed in the rear sight. In the EM-2 the front screw securing the sight to the bracket broke 4 times and periodically required tightening. In the FN the lateral adjustment screws of the rear sight worked loose, and wear on the adjustment catch of the rear sight prevented positive fastening.

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(d) Under normal light conditions the firers preferred the aperture sights of the T-25 and the FN. Under poor light, and under flares, the firer preferred the optical sight of the EM-2.

(4) Analysis:

(a) Stability of Sights: The order of merit is EM-2, T-25 and FN. The FN is not acceptably stable but can be made acceptable with minor modification.

(b) Durability of Sights: The order of merit is EM-2 and T-25, about equal, followed by the FN. The FN is not acceptably durable but can be made so with minor modification.

(c) Suitability of Sights: The order of merit for poor light conditions is EM-2, T-25 and FN; and in good light is T-25, FN and EM-2. All are acceptable.

(d) Battle Sights: None of the sights had a battle sight adjustment.

(e) The overall order of merit is EM-2, FN and T-25. The FN is not acceptable in its present form but can be made acceptable with minor modifications. The T-25 sight is not acceptable because of its basic design. (Appendix "C" T-5).

f. Test No. 6:

(1) Purpose: To determine the comparative accuracy of the test rifles when fired semi-automatically.

(2) Method:

(a) Phase I: To determine the comparative accuracy of the test rifles when fired from a bench rest.

(b) Phase II: To determine the comparative accuracy when fired by riflemen of varying degrees of proficiency.

(c) Phase III: To determine the accurace in sustained fire.

(d) Phase IV: To determine the change in accuracy and in center of impact caused by heating.

(e) Phase V: To determine the effect of the muzzle attachments on the accuracy and on the center of impact.

(3) Phase I:

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(a) Method:

1. Ten expert riflemen fired three groups of ten rounds each with two of each of the test rifles and the M-1, from a bench rest at ranges of 100, 200, 300 and 600 yards.

2. Three riflemen fired three groups of ten rounds each with two of each of the test rifles and the M-1 at ranges of 800 and 1000 yards, except that the FN was not fired at 1000 yards because the sight could not be locally modified for this range.

3. In order to determine the effect of firing on the rifles this test was refired by 8 of the original 10 riflemen at ranges of 100, 300 and 600 yards after about 5000 rounds had been fired from each rifle.

4. The mean radius, maximum horizontal and vertical variation, and maximum spread were computed.

(b) Results:

ACCURACY NEW BARRELS AND AFTER 5000 ROUNDS (See Figures 4 and 5)

Average Mean Radii in Feet

Range (Yds)	EM-2		FN		M-1		T-25	
	New Barrel	After 5000 Rds	New Barrel	After 5000 Rds	New Barrel	After 5000 Rds	New Barrel	After 5000 Rds
100	.18	.20	.21	.21	.18	.18	.14	.14
200	.35		.35		.38		.26	
300	.51	.55	.52	.57	.56	.59	.37	.39
600	1.01	.99	1.04	1.10	1.04	.99	.77	.79
800	1.40		1.62		1.39		1.07	
1000	2.11		Not Fired		2.13		1.56	

Figure No. 3

(c) Analysis: (See Figures 4 and 5)

1. There was very little difference between the accuracy of the EM-2 and the FN and both were about the same as the M-1 at ranges up to and including 600 yards.

2. The accuracy of the T-25 was superior to the accuracy of the EM-2, the FN, and the M-1.

3. The accuracy of the test rifles and the M-1 showed

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TEST 6, PHASE I.
ACCURACY OF ALL FIRERS.
NEW RIFLES.

SEMI-AUTOMATIC FIRE
NO TIME LIMIT

BENCH REST

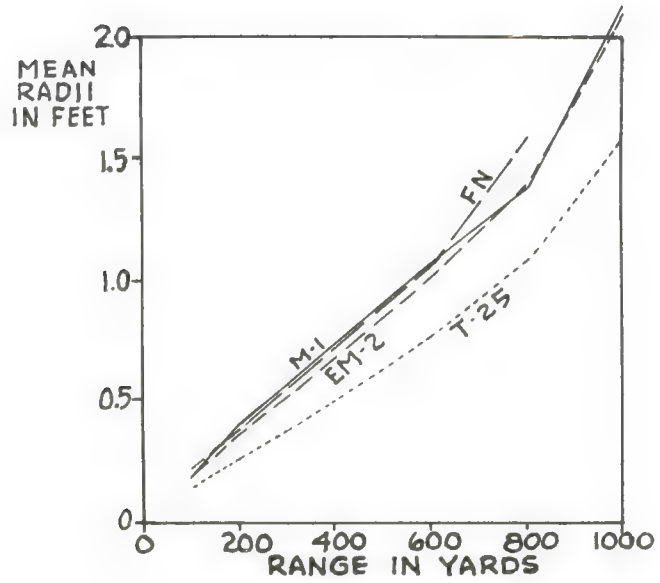

FIG. 4

TEST 6, PHASE I
ACCURACY OF ALL FIRERS.
AFTER 5000 ROUNDS.

SEMI-AUTOMATIC FIRE
NO TIME LIMIT

BENCH REST

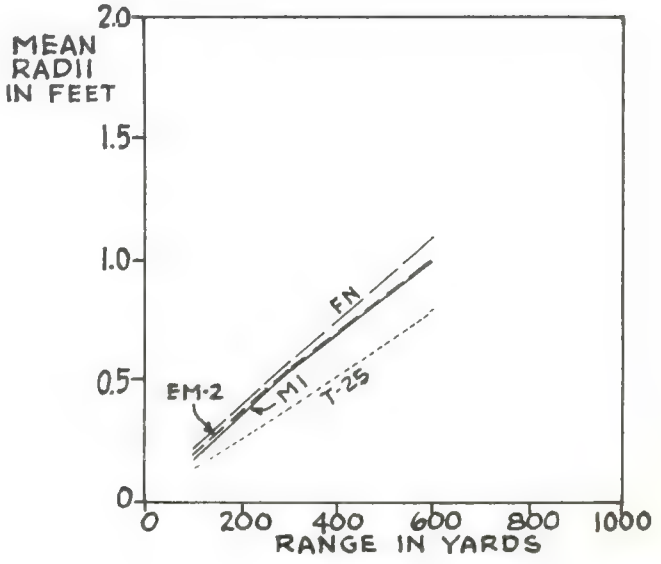

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FIG. 5

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very little difference from when the barrels were new and after they had fired 5000 rounds.

4. The accuracy of the test rifles was acceptable up to 600 yards, in comparison with the M-1.

5. The accuracy of the T-25 and EM-2, when compared with the M-1, was acceptable at ranges of 800 and 1000 yards.

6. It was not possible to compare the accuracy of the FN rifle at 800 and 1000 yards as it could not be properly sighted for these ranges.

(4) Phase II:

(a) Method:

1. Sixteen riflemen, consisting of six experts, seven average shots and three recruits, fired two of each of the test rifles and the M-1 rifle at ranges of 100, 200, 300 and 500 yards in the prone position using the loop sling.

2. Each rifleman fired three groups of 10 rounds each with each rifle at all ranges.

(b) Results:

1. ACCURACY OF EXPERTS, AVERAGE SHOTS, AND RECRUITS (See Figures 8, 9 and 10)

MR in Feet - Range in Yards

	EM-2				FN				M-1				T-25			
Proficiency	100	200	300	500	100	200	300	500	100	200	300	500	100	200	300	500
Experts	.21	.37	.58	1.16	.21	.40	.58	.99	.22	.41	.60	.95	.16	.32	.39	.59
Average	.29	.52	.72	1.10	.27	.50	.68	1.05	.28	.55	.70	1.10	.22	.40	.55	.73
Recruits	.47	.55	.86	1.22	.29	.53	.81	1.40	.30	.63	.78	1.20	.30	.62	.72	1.08

Figure No. 6

2. ACCURACY OF ALL FIRERS (See Figure 11)

(MR in Feet)

	EM-2	FN	M-1	T-25
100 yds	.29	.25	.26	.21
200 yds	.47	.47	.51	.41
300 yds	.69	.67	.68	.52
500 yds	1.14	1.09	1.07	.75

Figure No. 7

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TEST 6, PHASE II
ACCURACY FIRING
SEMI - AUTOMATIC FIRE. NO TIME LIMIT
PRONE POSITION

LEGEND
EM-2 – – – – – – –
FN — — — — —
M-1 ————————
T-25 - - - - - - - - - - - - - -

RECRUITS

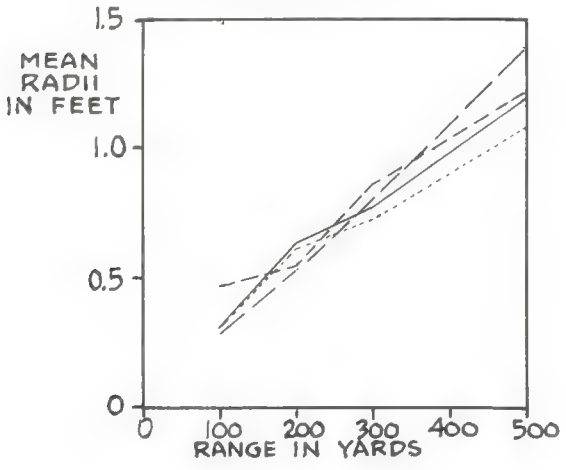

FIG. 8

AVERAGE FIRERS

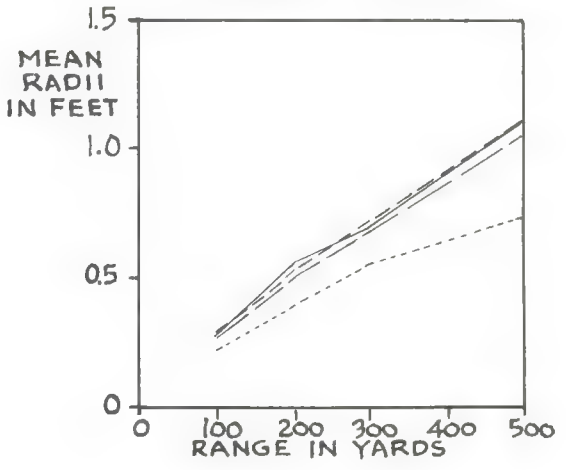

FIG. 10

EXPERTS

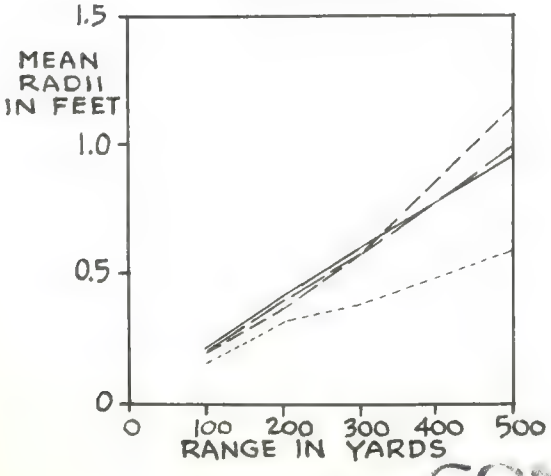

FIG. 9

ALL FIRERS

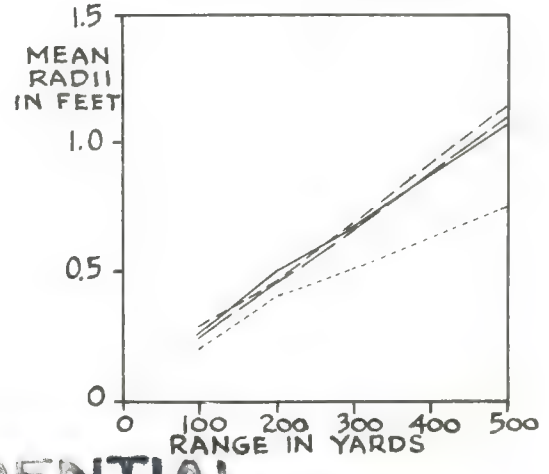

FIG. 11

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TEST 6, PHASE II.
DIFFERENCE IN ACCURACY BETWEEN EXPERTS & RECRUITS.
SEMI-AUTOMATIC FIRING.

NO TIME LIMIT.
PRONE POSITION.

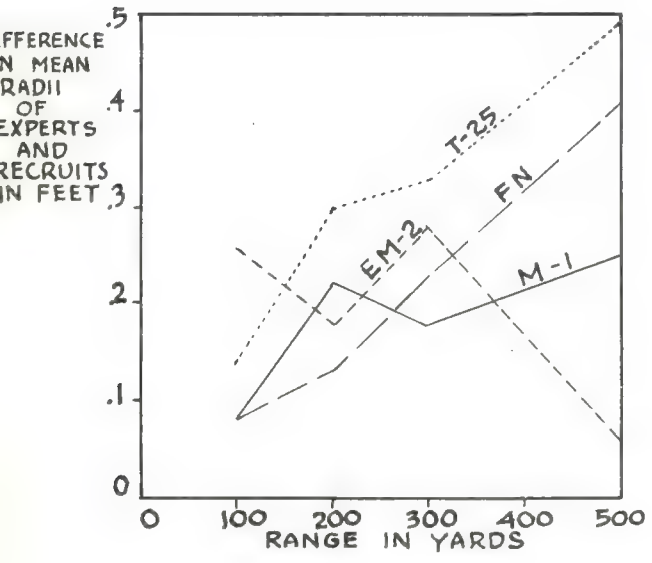

FIG. 13

TEST 6, PHASE II & III.
INCREASE IN MEAN RADII, ALL FIRERS, FROM SEMI-AUTOMATIC FIRE WITHOUT TIME LIMIT, TO SEMI-AUTOMATIC FIRE, 8 ROUNDS PER 25 SECONDS.
PRONE POSITION.

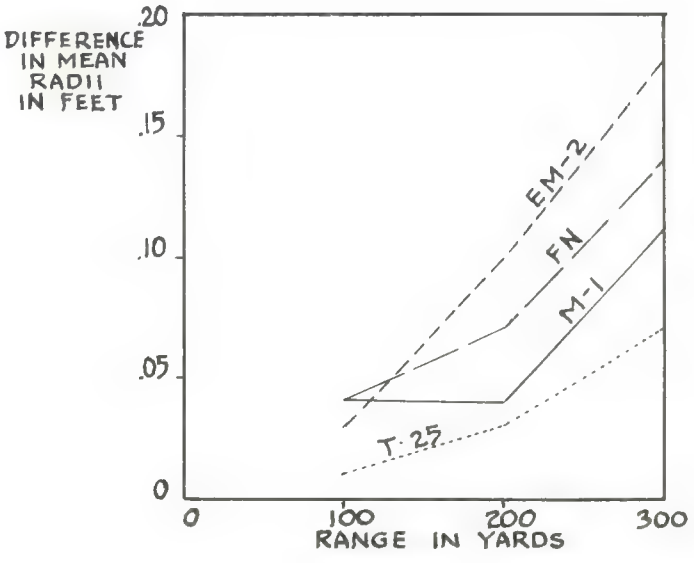

FIG. 15

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(c) Analysis:

1. The T-25 was more accurate than the EM-2, the FN and the M-1.

2. The accuracy of the EM-2, the FN and the M-1 was almost the same at all ranges.

3. The difference between the experts and the average shots was not marked.

4. The difference between the experts and the recruits was greater with the T-25 than with the EM-2, the FN and the M-1. (See Figure No. 13).

5. The accuracy of test rifles is acceptable.

(5) Phase III

(a) Method:

1. The same riflemen who fired Phase II, above, fired three groups of eight rounds each with two rifles of each type within a time limit of 25 seconds for eight rounds.

2. All firing was in the prone position with the loop sling at ranges of 100, 200 and 300 yards.

(b) RESULTS OF ACCURACY IN SUSTAINED FIRE (See Figure No. 14)

(Average MR in Feet)

	EM-2	FN	M-1	T-25
100 Yards	.32	.29	.30	.22
200 Yards	.57	.54	.55	.44
300 Yards	.87	.81	.79	.59

Figure No. 12

(c) Analysis:

1. The T-25 was more accurate than the EM-2, the FN and the M-1. (See Figure 14)

2. The accuracy of the EM-2, the FN, and the M-1 were almost the same.

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TEST 6 PHASE III

ACCURACY ALL FIRERS

SEMI-AUTOMATIC
SUSTAINED FIRE
(8 ROUNDS PER 25 SECONDS)

PRONE POSITION

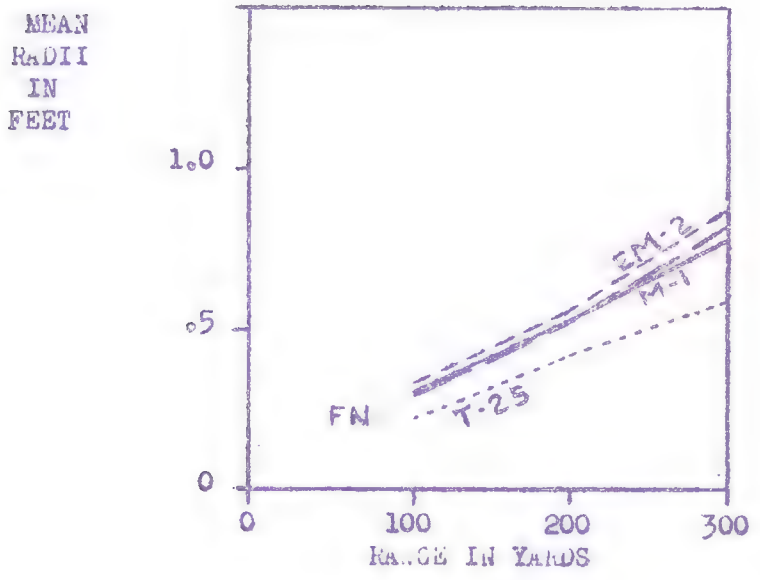

FIG. 14

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3. The difference in accuracy between the timed (Phase III) and untimed firing (Phase II) was most marked with the EM-2, and least marked with the T-25 (See Figure No. 15).

(6) Phase IV:

(a) Method:

1. Six expert riflemen who fired in Phase I fired a group of ten rounds from a cool barrel to establish a center of impact. Eighty rounds were then fired through the rifle semi-automatically to heat the barrel. Each riflemen then fired three groups of ten rounds each with one rifle of each type. Mean radius and change in center of impact were recorded.

2. All firing was from a bench rest at a range of 300 yards.

(b) Results:

CHANGE IN MR AND CI - COOL AND HOT BARREL
(Range - 300 Yards. Data in Feet)

Rifle	MR		Change in Center of Impact			
	Cool	Hot	Up	Down	Right	Left
EM-2	.59	.61		1.30	.12	
FN	.53	.62		1.18	.17	
M-1	.55	.63		.35	.24	
T-25	.35	.40		1.01	.10	

Figure No. 16

(c) Analysis:

1. The changes in the mean radii were insignificant with all rifles.

2. The change in the center of impact was least with the M-1. The center of impact with the three test rifles changed about the same. All were down about a foot and to the right about 2 inches.

3. The changes were acceptable.

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(7) Phase V:

(a) Method:

1. Nine expert riflemen who fired in Phase I fired 3 groups of ten rounds from a bench rest at a range of 300 yards with one type of each rifle without muzzle attachments in order to establish a center of impact.

2. Muzzle attachments were then placed on the rifles and 3 groups of ten rounds were fired. Changes in the mean radii and in the center of impact were recorded.

(b) Results:

CHANGES IN CI AND IN ACCURACY DUE TO ATTACHMENTS
(Data in Feet)

U - Up D - Down R - Right L - Left

Attachment	EM-2			FN			M-1			T-25		
	MR	CI Change U/D	CI Change R/L	MR	CI Change U/D	CI Change R/L	MR	CI Change U/D	CI Change R/L	MR	CI Change U/D	CI Change R/L
None	.59			.61			.60			.37		
Bayonet	.61	1.22U	.22R	.55	.60D	.55R	.87	1.00U	.35L	.38	3.77U	.36L
Comb.Bay & FH				.51	1.67D	.10L						
Grenade L.	.49	.41U	.67L	.82	.68U	.38L	.61	1.17U	.20L	.42	2.04U	1.36L
Flash Hider				.55	2.32D	.02L	.62	.26U	.38L			
Recoil Check				.44	1.17D	.28L						

Figure No. 17

(c) Analysis:

1. Attachments to all rifles caused changes in the centers of impact.

2. The only attachments in common to all rifles were the bayonet and the grenade launcher.

3. The change caused by attaching the bayonet and the grenade launcher to the T-25 was much greater than the change caused by similar attachments to the other rifles.

4. The change in the center of impact due to attachments is acceptable with the M-1, the EM-2, and the FN. It is not acceptable with the T-25.

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(8) Analysis of Test No. 6 as a Whole:

In semi-automatic fire the T-25 is the most accurate and the FN, EM-2 and the M-1 are about the same; all are acceptable except the T-25 when fired with bayonet and grenade launcher. The FN could not be tested at 1000 yards. (Appendix "C", T-6).

g. Test No. 7:

(1) Purpose: To determine the comparative accuracy of the rifles when firing automatic fire from a prone position with a muzzle and elbow rest with cool and hot barrels.

(2) Method:

(a) In order to compare the accuracy of the test weapons, 16 experienced men fired two of each type rifle, on bipod mount, at ranges of 25, 100, and 200 yards in three ten round groups each in bursts of 2 and 3 rounds and five rounds and in three 20 round groups in burst of 20 rounds.

(b) To obtain a comparison between hot and cool barrels the rifles were refired after preheating (by firing 80 rounds in 20 round bursts) at 50 yards in two and three round bursts.

(c) To compare the T-25 with heavy barrel with the Bren and BAR and to compare all three with the test rifles, six of the men fired 3 groups of 10 rounds each in two and three round bursts and 5 round bursts at 100 and 200 yards. 20 round bursts were fired at 100 yards.

(3) Results:

(a) ACCURACY, TEST WEAPONS
Cool Barrel
(Range in Yards, MR in Feet)

	EM-2	FN	T-25
Range	MR	MR	MR
2 & 3 Round Bursts			
25	.25	.18	.17
100	1.03	.65	.67
200	1.70	1.25	1.54
5 Round Bursts			
25	.27	.25	.23
100	1.13	.91	.87
200	(% of hits only could be obtained)		

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	20 Round Burst		
25	.23	.31	.31
100	.98	.99	.96
200	(% of hits only could be obtained)		

Figure No. 18

(b) COMPARATIVE ACCURACY, HOT & COOL BARRELS

50 Yards - 2 & 3 Round Bursts. Data in Feet

	Change in MR		Change in Center of Impact			
Rifle	MR Cool	MR Hot	Right	Left	Up	Down
EM-2	.49	.47	.11			.20
FN	.48	.45	.16			.27
T-25	.29	.35		.02		.19

Figure No. 19

(c) COMPARATIVE ACCURACY, BAR, BREN AND T-25 (HB)

Range in Yards. MR in Feet

Range	MR		
	BAR	Bren	T-25 HB
	2 & 3 Round Bursts		
100	.43	.34	.51
200	.75	.68	.78
	5 Round Bursts		
100	.69	.45	.65
200	.91	.99	1.11
	20 Round Bursts		
100	.52	.44	.69

Figure No. 20

(4) Analysis:

(a) At all ranges and lengths of bursts fired the three test rifles have about the same accuracy. (See Figure No. 21)

(b) None of the test rifles is as accurate as the BAR, Bren or T-25 (heavy barrel) under the conditions of the test; the Bren is 50%, and the T-25 (heavy barrel) 25 to 30% more accurate than the best of the test rifles at the ranges and rates of fire tested. (See Figure No. 21).

(c) The changes in MR and CI between cool and hot barrels are insignificant.

(d) Of the 3 automatic rifles (British LMG's), the Bren is the most accurate followed by the BAR and the T-25 (heavy barrel). (See Figure No. 21).

(e) The automatic fire accuracy of the test rifles (as light

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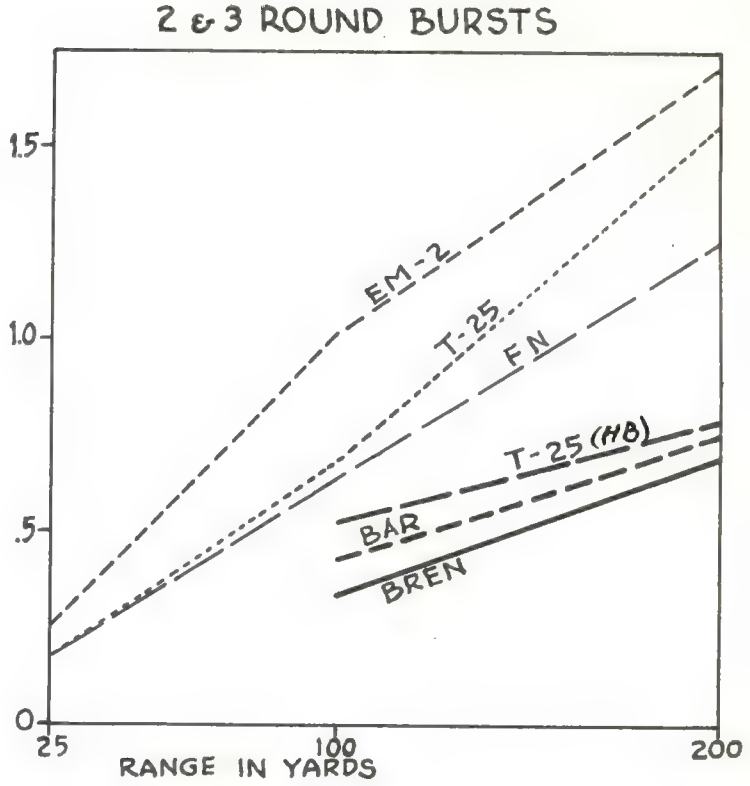
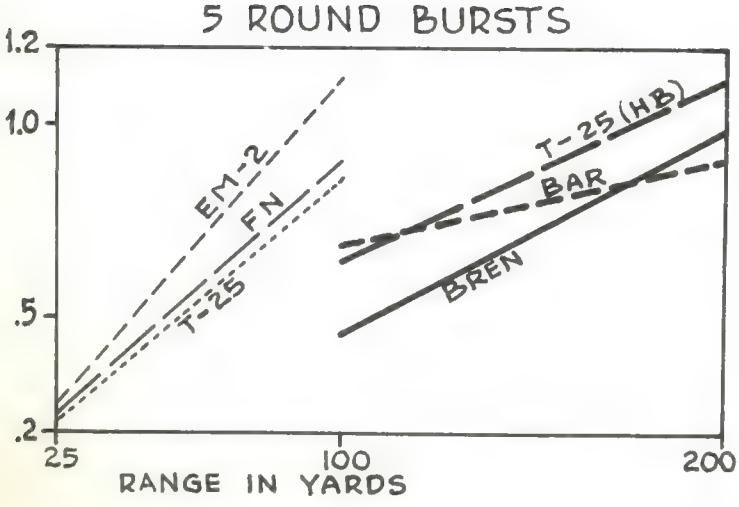
TEST 7
RANGE VS ACCURACY
AUTOMATIC FIRE

TEST WEAPONS VS BREN, BAR, & T-25 W/HEAVY BARREL

PRONE – BIPOD – COOL BARREL

MEAN RADII IN FEET





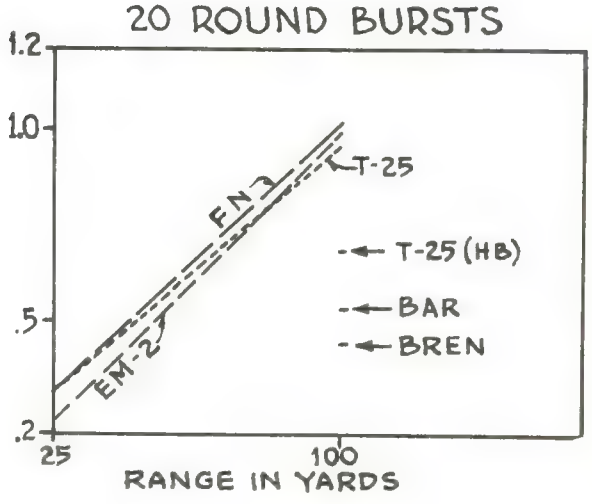


FIG. 21

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rifles when fired prone using a bipod) is acceptable but in no case does it meet the military characteristic requirements.

(f) Limitted firing of the T-25 (Heavy Barrel) indicates that the accuracy of the light rifles may be improved by adding a heavy barrel. (Appendix "C", T-7).

h. Test No. 8:

(1) Purpose: To determine the comparative automatic fire accuracy of the test rifles unsupported by artificial rests.

(2) Method:

(a) Sixteen riflemen previously trained in automatic firing of the rifles fired each model rifle twice using the loop sling.

(b) Firing was from the standing, kneeling and prone positions at ranges of 15, 25 and 50 yards.

(c) Firing was in bursts of 2 and 3 rounds, 5 rounds and 20 rounds.

(d) In each firing three groups of ten rounds were fired except for the 20 round burst when three 20 round groups were fired.

(e) The mean radius (MR), maximum horizontal (MH) and vertical (MV) dispersion, and maximum spread (MS) was measured for each group and the average computed.

(f) The dispersion was so great in the kneeling and standing positions at 50 yards that no computation was possible.

(3) Results:

(a) The results are tabulated below:

AVERAGES OF SHOT GROUPS IN FEET
2 and 3 Round Burst - 25 Yards

	MR			MH			MV			MS		
Position	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25
Prone	.74	.48	.86	1.47	.91	2.20	1.54	1.01	1.07	2.06	1.36	2.39
Kneeling	1.65	1.38	1.51	3.40	2.61	3.32	2.25	2.25	1.65	4.03	3.40	3.70
Standing	1.39	1.22	1.21	2.46	2.01	2.88	2.67	2.50	1.28	3.64	3.12	2.90

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50 Yards

	MR			MH			MV			MS		
Position	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25
Prone	1.25	.85	1.71	2.52	1.70	3.85	1.92	1.93	1.77	3.12	2.35	4.10

Figure No. 22
5 Round Burst
15 Yards

	MR			MH			MV			MS		
Position	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25
Prone	.43	.47	.60	1.06	1.19	1.80	.87	.92	.90	1.29	1.33	1.99
Kneeling	1.08	1.04	1.41	2.75	2.66	3.94	2.01	2.13	1.91	3.18	3.15	4.12
Standing	.91	1.02	1.16	1.99	2.28	2.73	2.09	2.56	1.98	2.69	3.14	3.16

50 Yards

	MR			MH			MV			MS		
Position	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25
Prone	1.46	1.50	1.95	3.56	3.48	4.68	2.19	2.52	2.51	4.02	3.96	5.07

Figure No. 23
20 Round Burst
15 Yards

	MR			MH			MV			MS		
Position	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25
Prone	.26	.42	.40	1.10	1.45	1.64	.64	.91	.95	1.20	1.65	1.83
Kneeling	.83	.79	1.03	3.02	2.94	3.36	1.92	2.22	2.29	3.31	3.37	3.74
Standing	.85	.94	1.08	2.68	2.88	2.78	2.13	2.51	2.62	3.16	3.47	3.40

50 Yards

	MR			MH			MV			MS		
Position	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25	EM-2	FN	T-25
Prone	.92	1.53	1.85	2.64	3.39	4.04	2.12	2.93	2.57	3.12	4.07	4.43

Figure No. 24

(4) Analysis:

(a) Comparative accuracy from different firing positions:

1. Prone (smallest MR)

2. Standing

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3. Kneeling (largest MR)
(See Figure No. 25)

(b) Comparative accuracy of bursts of various lengths:

1. 2 & 3 rounds (smallest MR)

2. 20 rounds

3. 5 rounds (largest MR)
(See Figure No. 25)

(c) Comparative accuracy of test rifles: The EM-2 and FN are equal, and both are superior to the T-25.

Note: The above comparisons a, b, and c are based on average mean radii. The three factors MH, MV, and MS may be considered as functions of MR.

(d) Comparison of test results with required standards:

1. None of the test rifles met the requirement that all shots from a five round burst shall strike, within a 24 inch circle when hand held in the standing position at a range of 50 yards. (See Military Characteristics of a Lightweight Rifle, Project No. 2227).

2. The automatic fire accuracy of the test rifles when fired under the condition of this test is acceptable at ranges up to 25 yards. (Appendix "C", T-8).

i. Test No. 9:

(1) Purpose: To determine the average number of hits obtained under simulated combat conditions with the rifles.

(2) Method:

The test was conducted in two phases, a semi-automatic firing phase and an automatic firing phase.

(a) Phase I - Semi-automatic:

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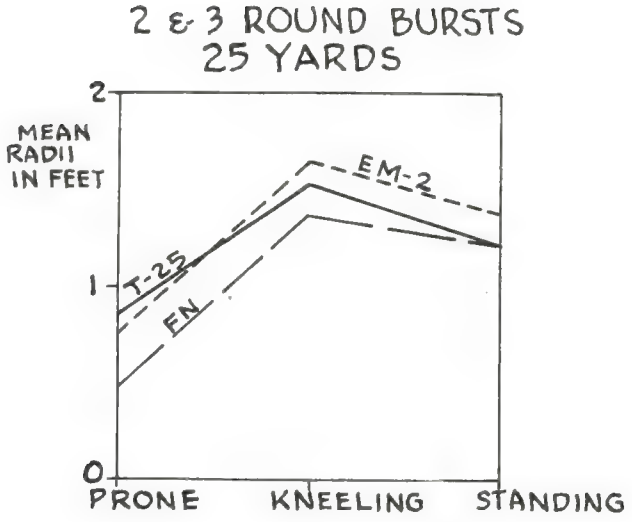
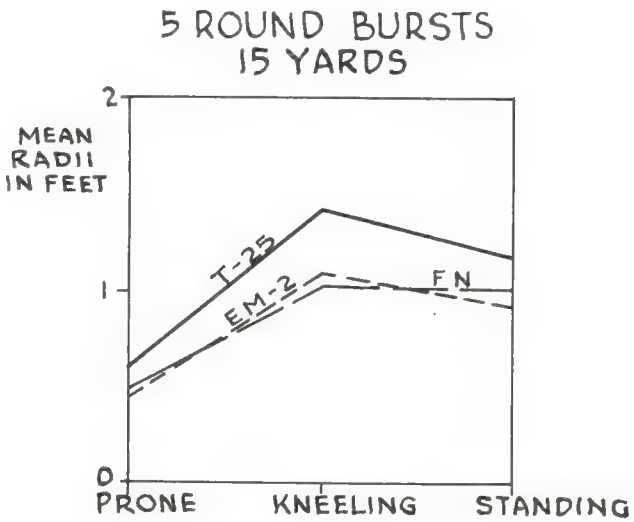
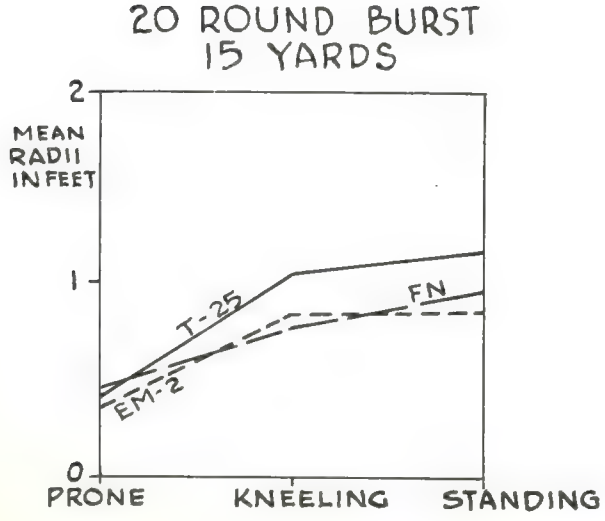
TEST 8
ACCURACY IN AUTOMATIC FIRE
EM-2, FN, AND T-25 RIFLES







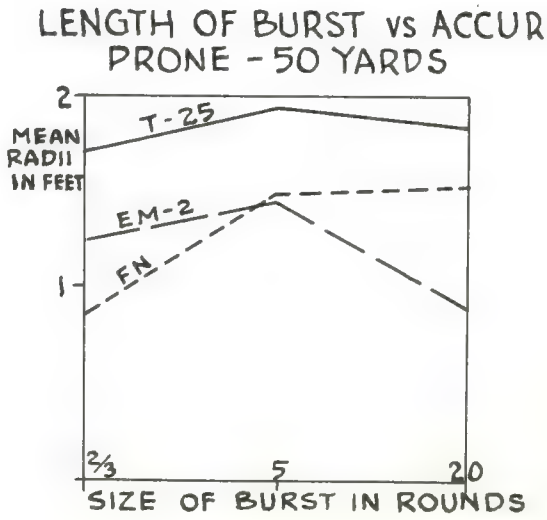


FIG. 25

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Sixteen soldiers thoroughly familiar with the weapons fired the M-1 and the three test rifles on a field range consisting of 10 firing points facing 10 firing lanes. The firing points provided varied stationary firing positions representing combat situations. Eight of the lanes contained stationary disappearing silhouettes, one contained a stationary 6 x 6 ft target and one contained two moving double silhouettes. The range to the targets varied from 150 to 500 yards. The time allowed to engage targets was limited, and a premium was given for unexpended rounds.

(b) Phase II - Automatic:

The same 16 soldiers fired two rifles of each type test rifle with bipod on a field range consisting of three firing points facing three firing lanes. Firing was from varied stationary firing positions representing combat situations. The first lane contained four stationary disappearing silhouettes, the second contained two moving double silhouettes and a stationary 6 x 6 ft target, and the third contained a lateral target and an oblique target, each consisting of 3 machine gun panels. The range to the targets varied from 150 to 500 yards. Time allowed to engage targets was limited.

(3) Results:

(a) Semi-automatic Fire:

Percentage of Targets Hit to Rounds Fired

EM-2	FN	M-1	T-25
44%	49%	58%	63.7%

Figure No. 26

(b) Automatic Fire:

Percentage of Targets Hit to Rounds Fired

EM-2	FN	T-25
32.9%	38.2%	32.9%

Figure No. 27

(4) Analysis:

(a) In Semi-automatic fire under simulated combat conditions the order of merit of the test rifles in percentage of hits was T-25, FN and EM-2. The T-25 was the only test rifle superior to the M-1 and was markedly superior to the FN and EM-2.

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(b) In Automatic fire, based on percentages of hits, the order was FN, EM-2, and T-25. The FN was considerably better than the EM-2 and T-25 which were approximately equal in percentage of hits produced. (Appendix "C", T-9).

j. Test No. 10:

(1) Purpose: To determine the comparative accuracy of the test rifles at the maximum rate of semi-automatic and automatic aimed fire.

(2) Method:

The sixteen firers employed in Test 6, Phase II, were given a brief drill in changing magazines with each rifle. Each firer then fired each rifle under the following conditions: Unlimited supply of ammunition, time limit of one minute; Semi-automatic fire from the prone position with loop sling at 200 yards; Automatic fire in 2 and 3 round bursts, with the bipod, from the prone position at 50 yards; and Automatic fire in 2 and 3 round bursts, without bipod, from the prone position with loop sling at 50 yards. Targets were 6 x 6 ft except in the case of automatic fire with bipod at 50 yards in which case a 6 x 10 ft target was used. Hits anywhere on the targets were counted.

(3) Results:

(a) SEMI-AUTOMATIC FIRE - 200 YARDS
(Average for 16 Firers, MR in Feet)

Rifle	Total Rounds Fired	Hits	% of Hits	MR
EM-2	41.4	36.2	87.4	1.33
FN	43.2	40.2	93.2	1.01
M-1	31.2	29.2	93.6	.90
T-25	42.4	40.4	95.3	.78

Figure No. 28

(b) AUTOMATIC FIRE W/BIPOD - 50 YARDS
(Average for 16 Firers, MR in Feet)

Rifle	Total Rounds Fired	Hits	% of Hits	MR
EM-2	85.2	79.4	93.2	.95
FN	65.7	62.1	94.6	.89
T-25	80.2	75.0	93.6	.90

Figure No. 29

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(c) AUTOMATIC FIRE W/O BIPOD - 50 YARDS
(Average for 16 Firers, MR in Feet)

Rifle	Total Rounds Fired	Hits	% of Hits	MR
EM-2	69.1	62.8	90.9	1.65
FN	58.4	55.7	95.3	1.11
T-25	55.9	37.4	66.9	2.74

Figure No. 30

(4) Analysis:

(a) In semi-automatic fire the T-25 was better than the control weapon (M-1) in rounds per minute and in accuracy (in percentage of hits) while the FN and the EM-2 were better than the control weapon in rounds fired per minute but not so good in accuracy (in percentage of hits). In hits per minute the order of merit was first T-25 and FN (approximately equal), second EM-2, and third M-1.

(b) In automatic fire with the bipod the EM-2 was better in rounds fired per minute than the T-25 and much better than the FN, but in accuracy (in percentage of hits) the three weapons were approximately equal. Based on hits per minute the T-25 and EM-2 were approximately equal and considerably better than the FN.

(c) In automatic fire without bipod the EM-2 was considerably better in rounds fired per minute than the FN and T-25, which were approximately equal; but the FN was more accurate (in percentage of hits) than the EM-2 and much more accurate than the T-25. In hits per minute the order of merit was first EM-2, second FN, third, and much the poorest, T-25.

(d) The overall effectiveness in automatic fire with and without bipod, considering accuracy (in percentage of hits) and hits per minute, was first EM-2, second FN and third T-25.

(e) In automatic fire without the bipod there was a significant loss of accuracy (27% in percentage of hits) in the T-25 which was not present with the other two weapons. (Appendix "C", T-10)

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k. Test No. 11:

(1) Purpose: To determine the most effective semi-automatic and automatic rate of fire of the test rifles.

(2) Method:

(a) For the purpose of this test the term "most effective rate of fire" has been interpreted as being that rate of fire which gives maximum accuracy and maximum rapidity of fire without damaging the rifle.

(b) To determine the most effective semi-automatic and automatic rates of fire, a study was made based on the results of Tests No. 6, 7, 8, 10 and 12.

(3) Results:

(a) SEMI-AUTOMATIC:

1. a. A consideration of the results of the accuracy firing in Test No. 6, Phases I and II, and Test No. 10 produces the following data:

200 YARDS PRONE WITHOUT BIPOD
(MR in Feet)

R P M	EX-2	FN	T-25
4	.47	.47	.41
19	.57	.54	.44
42	1.33	1.01	.78

Figure No. 31

b. This data shows that all test weapons can fire with accuracy at 42 rounds per minute for a limited time and that their accuracy at 19 rounds per minute is almost as good as at 4 rounds per minute.

2. From the results of Test No. 12 it can be seen that:

a. All of the test weapons can fire at a rate of 15 rounds per minute for 30 minutes without damage.

b. None of the weapons can fire at a rate of 20 rounds per minute for 30 minutes without damage.

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c. After approximately 180 rounds, all of the rifles will overheat to the extent that they cannot be held in the bare hand.

3. Therefore: The most effective rate in semi-automatic fire for the three test weapons is 15 rounds per minute for 30 minutes, provided that the hands are protected.

(b) AUTOMATIC:

1. A consideration of the results of the accuracy firing in Tests No. 7, 8, and 10 produces the following data:

a. From Test No. 7.

100 YARDS WITH BIPOD
(MR in Feet)

Burst in Rounds	R P M	EM-2	FN	T-25
2 & 3	15	1.03	.65	.67
5	25	1.13	.91	.87
20	60	.98	.99	.96

Figure No. 32

b. From Test No. 8:

50 YARDS WITHOUT BIPOD
(MR in Feet)

Burst in Rounds	R P M	EM-2	FN	T-25
2 & 3	15	1.25	.85	1.71
5	25	1.46	1.50	1.95
20	60	.92	1.53	1.85

Figure No. 33

c. From Test No. 10:

50 YARDS UNLIMITED AMMUNITION FOR ONE MINUTE
(2 & 3 Round Bursts)

Bipod	EM-2 (85 RPM)	FN (66 RPM)	T-25 (80 RPM)
With	.69	.85	.56
Without	1.65	1.11	2.74

Figure No. 34

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2. The above data shows that:

a. Five round bursts are the least accurate and 2 and 3 round bursts are the most accurate.

b. Accuracy is maintained up to 60 rounds per minute, but over this rate, accuracy decreases rapidly.

c. Therefore, a rate of fire of 60 rounds per minute in 2 & 3 round bursts is the most effective rate if it can be maintained.

3. Test No. 12, however, produced the following results:

a. All test weapons can fire 40 rounds per minute in two and three round bursts for 5 minutes without damage.

b. None of the test weapons can fire at the rate of 60 rounds per minute in two and three round bursts for 5 minutes without damage.

c. After approximately 180 rounds, all of the weapons are too hot to hold in the bare hand.

4. Therefore: The most effective rate in automatic fire for the test weapons is 40 rounds per minute for five minutes in two and three round bursts, provided the hands are protected.

(4) Analysis:

(a) The most effective rate of fire of the test weapons in semi-automatic fire is 15 rounds per minute for 30 minutes.

(b) The most effective rate of fire of the test weapons in automatic fire is 40 rounds per minute for five minutes.

(c) In both semi-automatic and automatic fire, the maximum effective rate and the maximum sustained rate of the test weapons are identical. (Appendix "C", T-11).

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1. Test No. 12:

(1) Purpose: To determine the approximate semi-automatic and automatic sustained fire capabilities of the test rifles.

(2) Method:

(a) The test rifles were fired semi-automatically at 15 and 20 rounds per minute for 30 minutes and automatically at rates of 40 and 60 rounds per minute for five minutes. The test was run once using one rifle of each type.

(b) A record was kept of malfunctions, the number of rounds at which heat was first felt and when heat became excessive, the degree of smoking at various stages, and when mirage became excessive.

(3) Results:

(a) Semi-automatic fire:

1. 15 rounds per minute for 30 minutes: All three test rifles were capable of maintaining this rate providing the firer was equipped with gloves. However, in each case the forward hand grip became too hot to hold in the unprotected hand, and in firing the EM-2 rifle the trigger also became too hot to touch.

2. 20 rounds per minute for 30 minutes: The EM-2 and FN (but not the T-25) could maintain this rate. However, the barrels became so hot the interior of the handguards became charred.

(b) Automatic fire:

1. 40 rounds per minute for 5 minutes: All of the rifles maintained this rate for 5 minutes without damage.

2. 60 rounds per minute for 5 minutes: This rate could not be maintained by the T-25 for 5 minutes. The EM-2 and FN could maintain this rate, but the interior of the handguard of the weapons became charred.

(4) Analysis:

(a) All of the test rifles can maintain a sustained rate of semi-automatic fire of 15 rounds per minute for 30 minutes.

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(b) The EM-2 and FN can maintain a sustained rate of semi-automatic fire of 20 rounds per minute for 30 minutes. The T-25 is not capable of maintaining this rate of sustained semi-automatic fire.

(c) All of the test rifles can maintain a sustained rate of automatic fire of 40 rounds per minute for 5 minutes.

(d) The EM-2 and FN can maintain a sustained rate of automatic fire of 60 rounds per minute for 5 minutes. The T-25 can not maintain this rate of sustained automatic fire.

(e) The EM-2 was able to maintain this sustained rate of fire after firing about 140 rounds only because the firer was permitted to wear a glove on his trigger finger.

(f) The forward hand grips of all the tested rifles became too hot to hold after firing about 180 rounds of sustained fire both in semi-automatic and automatic firing. (Appendix "C", T-12)

m. Test No. 13:

(1) Purpose: To determine the comparative effectiveness of a rifle squad armed with the test rifles and as currently armed, when firing from a fixed position at 250 yards.

(2) Method: (The purpose and, consequently, the method of Test No. 13 was altered from the Plan of Test by the UK and US representatives at AFF Board No. 3 because of practical difficulties: Lack of time due to the moving forward of the completion date of the tests; insufficient manpower and ranges readily available; shortage of qualified squad instructors).

(a) Nine men fired a squad problem consisting a linear target of ten silhouettes, representing an enemy squad, and a point target of two silhouettes, representing an enemy machine gun. The squad fired the problem twice using semi-automatic fire and twice using automatic fire with each type test rifle and twice with standard weapons (8 M-1s and one BAR). When firing automatic fir two test rifles in each firing were equipped with bipods 220 rounds of ammunition were allotted for each firing. Hits, including ricochets, were scored on the targets and on camouflaged screens behind the targets. However, for the purpose of rating the rifles for effectiveness of fire only the hits on the screens were considered.

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(3) Results:

TOTAL HITS FOR TWO FIRINGS SEMI-AUTOMATIC
(Out of 440 Rounds)

Rifle	Screen
T-25	307 (69.8%)
M-1	285 (64.8%)
EM-2	276 (62.7%)
FN	271 (61.6%)

Figure No. 35

TOTAL HITS FOR TWO FIRINGS AUTOMATIC
(Out of 440 Rounds)

Rifle	Screen
T-25	170 (38.6%)
EM-2	157 (35.7%)
FN	146 (33.2%)

Figure No. 36

(4) Analysis:

(a) In semi-automatic fire the T-25 squad was the most effective and the FN was the least effective.

(b) The M-1 squad was slightly more effective than the EM-2 squad.

(c) In automatic fire there was no great difference between the 3 test rifles squads, the T-25 being slightly better than the EM-2 and the FN.

(d) All rifle squads obtained more hits on the screens in semi-automatic than automatic fire. (Appendix "C", T-13)

n. Test No. 13½:

(1) Purpose: To determine the suitability of muzzle attachments for performing designed functions.

(2) Method: The attachments were tested to determine their effect on the rifles in recoil, stability, and balance, their suitability to perform the functions for which they were designed, their effect on accuracy and point of impact, and their ease and secureness of fastening. Attachments for the three weapons were:

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EM-2	FN	T-25
Bayonet	Bayonet	Bayonet
Grenade Launcher	Grenade Launcher	Grenade Launcher
	Flash Hider	
	Stabilizer	
	Combination Bayonet and Flash Hider	

(3) Results:

(a) Attachments for all rifles were secure and easy to attach and detach, except the grenade launcher for the T-25 which was difficult to remove when hot and the bayonet for the T-25 which was not secure.

(b) The attachments for all rifles had no appreciable effect on recoil, stability and balance (when carried with a full magazine in position) except that the stabilizer of the FN reduced recoil and its muzzle attachments improved its balance (when carried with a magazine loaded, it is butt heavy).

(c) For performing their designed functions:

1. The grenade launchers of all three test rifles were about equally suitable. (Test No. 17).

2. The flash hider of the FN considerably reduced flash (Test No. 18).

3. The bayonets of the FN and EM-2 were equally suitable. However, the bayonet of the T-25 broke across the handle (Test No. 14).

(d) The effect of the attachments on accuracy and point of impact for the EM-2 and FN were negligible. The bayonet and grenade launcher of the T-25 caused unacceptable changes in the center of impact. (Test No. 6, Phase V).

(4) Analysis:

All attachments, except the bayonet for the T-25, were suitable for performing the functions for which they were designed. However, the bayonet and grenade launcher for the T-25 caused unacceptable changes in the center of impact. (Appendix "C", T-13½)

o. Test No. 14:

(1) Purpose: To determine the suitability of the tested rifles for bayonet fighting.

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(2) Method:

All rifles were equipped with bayonets. The M-1 was used as a control item. Observations were made as to the ease of affixing bayonets and the balance of rifles after the bayonet was affixed. Eighteen men of varying degrees of training ran a bayonet course, similar to the old standard U.S. course, with a few obstacles from the British course added. No time limit was imposed; and all types of strokes, thrusts, withdrawals and parries were used. The men were questioned, and observations were made, as to the ease of handling the weapons during the running of the course. It was planned to have each man run the course twice with each type rifle. However, due to excessive breakage of the test rifles, the test was discontinued after the course had been run 62 times.

(3) Results:

(a) During the conduct of tests, no difficulties were encountered in fixing bayonets, no bayonets came off and all rifles were easy to handle in bayonet fighting. However, when using the EM-2 difficulty was encountered in delivering the horizontal butt stroke because of the location of the magazine.

(b) The following breakages occurred:

Rifle:	M-1	T-25	EM-2	FN
Breakage:	None	2-broken bayonets. 1-broken stock.	Butt plate released once. 2-butt catches bent. Magazines were released 4 times, due to right hand slipping forward on the thrust and striking the magazine release.	2 stocks cracked 1 stock broken off of rifle.

(4) Analysis:

(a) The test rifles are suitable for bayonet fighting with respect to ease of handling. The EM-2 is slightly less desirable than the other rifles because of the location of the magazine.

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(b) All test rifles in their present form are unsuitable for bayonet fighting due to lack of durability.

(c) None of the test rifles were comparable to the M-1 in durability for bayonet fighting. (Appendix "C", T-14)

p. Test No. 15:

(1) Purpose: To determine the facility and ease with which currently accepted firing positions can be assumed by men of varied conformations, including left-handed men.

(2) Method:

(a) The U. S. M-1 rifle was used as the control item.

(b) Seven men of reasonably varied physical conformations and a left-handed man were tested in each standard firing position with each rifle.

(c) During all tests, firers were watched and from time to time questioned as to the ease of assuming firing positions with each of the test rifles.

(3) Results:

(a) Semi-automatic Fire:

1. M-1: No difficulties in any position.

2. EM-2: No difficulties in any position.

3. FN: Taller men had some difficulty in all positions in getting their eye in line with the sights.

4. T-25: Magazine interfered with left elbow under rifle. The left hand of the firers contacted the operating rod.

(b) Automatic Fire:

1. The same difficulties in assuming positions were encountered as in Semi-automatic fire.

2. In the standing and kneeling positions, it was found desirable to lean forward with all test rifles to compensate for recoil.

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(c) The left-handed man used in this test had no difficulty in assuming standard firing positions with any of the test rifles, but the EM-2 cannot be fired from the left shoulder because the ejection way coincides with his cheek rest.

(4) Analysis:

(a) Using the various test weapons and the M-1 rifle, it was possible for men of reasonably varied conformations to assume all firing positions without major difficulties and with somewhat nearly equal ease for all of the weapons.

(b) Tall men had some difficulty with the FN in getting their eye in line with the sight; the location of the magazine on the T-25 interfered slightly with the firer's placing his elbow under the rifle; and the EM-2 could not be fired from the left shoulder. (Appendix "C", T-15).

q. Test No. 16:

(1) Purpose: To determine the dependability and adequacy of the safety devices of the test rifles.

(2) Method:

(a) Safety devices were examined and their functioning noted.

(b) During the conduct of all tests, safety devices of all rifles were used normally. Any difficulties or failures of the safety devices to operate correctly were noted.

(3) Results:

(a) Applied Safety:

1. T-25: Functioned correctly throughout.

2. EM-2: After a moderate amount of use there was a tendency for the safety lever to be moved to the safe position by the vibration of the gun due to insufficient tension of the spring positioning the safety lever.

3. FN: No malfunctions of the safety lever were observed.

(b) Integral Safety Features: Throughout the tests there

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were no malfunctions of the integral safety devices of any of the test weapons,

(c) From observation throughout the firing tests it was determined that the safety devices for all of the test rifles were adequate.

(4) Analysis:

With respect to dependability and adequacy of the safety features of the test rifles all three were satisfactory and about equal, except that the applied safety feature of the EM-2 requires very minor modification. (Appendix "C", T-16).

r. Test No. 17:

(1) Purpose: To determine the suitability of the test rifles for launching grenades and adaptability for launching grenades from currently accepted firing positions.

(2) Method:

(a) In order to determine the accuracy and maximum range of the test rifles and the M-1, M11A2 practice grenades were fired with the rifles mounted in a gun rest in a machine gun tripod. Five grenades were fired from each rifle, at 100, 150 yards and maximum range. Mean radius, maximum vertical and maximum horizontal dispersion and maximum spread were measured.

(b) To determine the adaptability of the rifles to currently accepted grenade firing positions five men fired two grenades from each of the four rifles in the standing, kneeling and prone positions.

(3) Results:

(a) ACCURACY AND MAXIMUM RANGE
(Measurements in Feet)

Weapon	100 Yards				150 Yards				Maximum Range Firing			
	MR	MH	MV	MS	MR	MH	MV	MS	Max. Range	Elev.	MR	MS
EM-2	2.7	5.8	5.5	8.1	4.9	9.2	10.3	13.0	623	40°	41	100
FN	2.6	4.1	5.8	7.3	6.0	11.8	11.2	15.2	728	35°	34	95
M-1	2.6	4.1	4.1	6.9	5.8	10.7	13.0	14.3	774	40°	29	107
T-25	2.6	5.5	6.1	7.7	5.7	10.9	12.4	15.7	809	40°	21	59

Figure No. 37

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(b) Adaptability to Firing Positions:

1. In the prone position difficulty was encountered in sighting test rifles at low elevations because of the pistol grip and magazine underneath the stock.

2. A sight over the top of the rifle, as provided with the EM-2 and the FN, was preferred by all firers to the sight on the side, as provided with the M-1. No sight was provided for the T-25.

3. All but the tallest men had difficulty sighting over the top of the FN sight in the standing and kneeling positions.

4. No damage was incurred by any of the rifles in firing from currently accepted firing positions.

5. The kick of the EM-2 was least severe and that of the M-1 most severe. Of the test rifles the T-25 was the most severe.

(4) Analysis:

(a) All test rifles are suitable for launching grenades and adaptable to launching grenades from currently accepted firing positions.

(b) While differing in various respects in the overall, the test rifles and the M-1 were about equally acceptable. (Appendix "C", T-17).

s. Test No. 17½:

(1) Purpose: To determine if the test rifles are strong enough to withstand the hard usage of field service.

(2) Method:

Ten soldiers were required to traverse a series of seventeen obstacles ten times. The men were armed with two T-25 (sights up), two T-25 (sights down), two EM-2, two FN and two M-1 rifles. The seventeen operations consisted of crawling through dust and brush, knocking down stacked arms, driving over rough terrain with rifles loose in the bottom of a truck, running and hitting the ground, submerging the rifles in water, etc. After each cycle of 17 operations,

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the rifles were cheek fired for zero and stoppages.

(3) Results:

(a) In crawling and moving through brush:

1. The projections of the T-25 caught in grass and brush or the sights were knocked down 46 times.

2. The projections of the EM-2 caught in brush 12 times, the magazine was released 3 times, and the safety lever moved from safe to fire 5 times.

3. The projections of the FN caught in grass 6 times and the sight worked loose or changed setting 3 times.

(b) Traversing Obstacles:

There were minor incidents with all weapons. The sights of the T-25 were knocked down 7 times, the safety of the EM-2 became unlocked 5 times, and sand got in the chamber of the FN 3 times.

(c) Rifles stacked and knocked to floor:

1. The T-25 safety moved from safe to fire once.

2. The change lever on the FN broke once and the breech cover was bent and torn once.

(d) Stoppages resulting:

STOPPAGES PER RIFLE PER 100 ROUNDS	
T-25	14.7
FN	17.0
EM-2	6.5
M-1	3.0

Figure No. 38

(e) Change in zero as result of obstacle course: None

(4) Analysis:

(a) The rifle which impeded the progress of the soldier the least during movement through heavy brush, grass and across rough terrain was the M-1 followed in order by

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the FN, EM-2 and T-25. For every incident with the M-1 there were 1.5 incidents with the FN, 3 with the EM-2 and 8 with the T-25.

(b) In ability to withstand hard usage under the conditions of this test, only minor damage was incurred. Test No. 14, however, finds the rifles unacceptable in durability for bayonet fighting.

(c) In ability to fire immediately after hard usage (as distinguished from mechanical damage) all three test rifles are inferior to the M-1. The EM-2 approaches the M-1 most closely and is considerably superior to the other two. In this respect the EM-2 is of marginal acceptability and the FN and T-25 are unacceptable. (Appendix "C", T-17½).

t. Test No. 18:

(1) Purpose: To determine the comparative visibility of the muzzle flash of the test rifles during darkness and of the smoke during daylight.

(2) Method:

(a) The three test rifles and the M-1 were in turn fired from a single firing point with observers stationed both to the front and to the flank.

(b) Each rifle fired five single rounds at 2 second intervals followed by 10 rounds in 2 & 3 round bursts, 10 rounds in one burst and twenty rounds in one burst.

(c) Observers reported the size, color and density of the smoke during daytime and the color, brilliance and size of the flash at night.

(d) The tests were run twice, once with cool barrels and once with hot barrels.

(e) During all firing in other tests rifles were observed for smoke and flash.

(3) Results:

(a) SMOKE
(Distance in Yards)

Weapon	Type of Fire	Distance smoke was observed	
		Front	Flank
EM-2	SA	200	200
	A	300	200

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(a) (Continued)

Weapon	Type of Fire	Distance smoke was observed Front	Flank
FN	SA	300*	300
	A	500*	300
M-1	SA	200	300
T-25	SA	200	300
	A	800	300

Figure No. 39

* Only one round and one burst observed.

(b) FLASH

(Distance in Yards)

Weapon	Type of Fire	Distance Flash was observed Front	Flank
FN-2	SA Cold Barrel	0	0
	SA Hot Barrel	0	100 (Sparks only)
	A	100	100 (Sparks only)
FN	SA Cold Barrel	1000	300
	SA Hot Barrel	1000	300
	A	1000	300
FN w/Flash Hider	SA Cold Barrel	100	100
	SA Hot Barrel	300	100
	A	1000	300
M-1	SA	500	300
T-25	SA Cold Barrel	800*	300
	SA Hot Barrel	800	200
	A Hot & Cold Barrel	1000	300

Figure No. 40

* Only one round observed.

(c) Observers reported the volume and density of the smoke of the T-25 was greater than for the other test rifles.

(d) From observation of all firing during all tests it was apparent that the flash and smoke from the T-25 was greater than that of the other rifles.

(4) Analysis:

In the suppression of smoke and flash the FN-2 using .280 caliber test ammunition is acceptable. The T-25 using the .30 caliber test ammunition is not acceptable. The FN using the .280 caliber test ammunition is acceptable in the suppression of smoke, but unacceptable in the suppression of flash. (Appendix "C", T-18).

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u. Test No. 19:

(1) Purpose: To determine the efficiency of the test rifles in semi-automatic and automatic fire as assault weapons.

(2) Method:

(a) The M-1 was used as a control weapon in semi-automatic fire.

(b) A combat firing lane was designed, approximately 130 yards in length, containing a number of counter-balanced disappearing targets consisting of one, two or three kneeling silhouettes.

(c) Each of sixteen firers were required to proceed down the lane, one at a time, and fire at each target as it was briefly exposed.

(d) Each man fired the course twice in semi-automatic fire with each type rifle and twice in automatic fire with each test rifle.

(e) Hits were scored and facility of manipulating and handling the test weapons was observed.

(3) Results:

(a) SCORE - SEMI-AUTOMATIC
(Average of All Firers)

Rifle	Rounds Fired	Hits	Score (based on 100)
EM-2	20	18.3	91.6
FN	20	18.4	92.2
M-1	20	17.5	87.6
T-25	20	17.6	88.0

Figure No. 41

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(b) SCORE - AUTOMATIC
(Average of All Firers)

Rifle	Rounds Fired	No. Targets Hit	Hits	Score (based on 152)
EM-2	60	17	25.6	114.8 (75.6%)
FN	60	18	29.1	125.7 (82.5%)
T-25	60	16	24.8	105.7 (69.9%)

Figure No. 42

(c) All firers reported that the test rifles were equally easy to handle.

(4) Analysis:

(a) The EM-2 and FN were slightly more effective than the T-25 and the M-1 in delivering assault fire with semi-automatic fire.

(b) The FN was the most effective of the test rifles in delivering assault fire with automatic fire. The FN was 6.9% better than the EM-2 and 12.6% better than the T-25.

(c) Although the test subjects reported all rifles equally easy to handle, the results of firing would indicate that the test weapons were easier to handle than the M-1 and that the order of handiness of the test rifles was FN, EM-2 and T-25.

(d) All weapons were acceptable. (Appendix "C", T-19)

v. Test No. 20:

(1) Purpose: To determine the average number of hits obtained per pound of ammunition expended under simulated combat conditions.

(2) Method:

(a) The number of hits per pound of ammunition expended for each type rifle was computed from the data obtained in:

1. Test No. 9: Hits obtained under simulated combat conditions from a variety of static firing positions using both semi-automatic and automatic fire, at field targets at an average range of 300 yards.

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2. Test No. 13: Hits obtained by a rifle squad firing both semi-automatic and automatic fire from a fixed position at an area target at a range of 250 yards.

3. Test No. 19: Hits obtained in simulated assault firing at disappearing targets at an average range of 30 yards while advancing, using both semi-automatic and automatic fire.

(b) The data obtained on the M-1 in the semi-automatic firing in the above tests was included as a basis for comparison.

(3) Results:

(a) Note: The number of rounds per pound for the three types of ammunition are caliber .280 ball, 21.88; caliber .30 T-104 ball, 19.05; caliber .30 M-2 ball, 17.86.

(b) HITS PER POUND - SEMI-AUTOMATIC FIRING

	Rounds Fired			Hits			
Weapon	Test No. 9	Test No. 13	Test No. 19	Test No. 9	Test No. 13	Test No. 19	Hits Per Pound
FN	1052	440	640	459	139	586	12.2
EM-2	1020	440	640	501	123	590	12.7
M-1	1001	440	640	576	119	561	10.8
T-25	961	440	640	612	201	563	12.9

Figure No. 43

(c) HITS PER POUND - AUTOMATIC FIRING

	Rounds Fired			Hits			
Weapon	Test No. 9	Test No. 13	Test No. 19	Test No. 9	Test No. 13	Test No. 19	Hits Per Pound
EM-2	2560	440	1920	833	63	809	7.6
FN	2560	440	1920	978	78	932	8.8
T-25	2560	440	1920	833	74	793	6.6

Figure No. 44

(d) HITS PER POUND - SEMI-AUTOMATIC & AUTOMATIC

Weapon	Total Rds Fired SA & A Firing	Total Hits SA & A Firing	Hits Per Pound
EM-2	7052	2889	9.0
FN	7020	3202	10.0
T-25	6961	3076	8.4

Figure No. 45

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(4) Analysis:

(a) In hits per pound in semi-automatic fire only the three test rifles were about equal (T-25, 12.9; EM-2, 12.7; FN, 12.2) and all were superior to the M-1 (10.8).

(b) In hits per pound in automatic fire only the order of merit was FN (8.8), EM-2 (7.6) and T-25 (6.6).

(c) In average number of hits obtained per pound of ammunition expended under simulated combat conditions, considering both semi-automatic and automatic fire, the order of merit was FN (10.0), EM-2 (9.0) and T-25 (8.4). (Appendix "C", T-20).

w. Test No. 21 (Omitted)

x. Test No. 22:

(1) Purpose: To determine the suitability of the test rifles for Airborne use.

(2) Method:

(a) Abbreviated tests were conducted by Army Field Forces Board No. 1 to determine if the rifles could be successfully jumped by parachutists by standard means. The durability, as such, was not tested.

(b) The test rifles were jumped without container on the parachutist, inside the container (container, rifle, adjustable, parachutist) on the parachutist, and inside the container lowered on a 20 foot rope beneath the parachutist. Two of each type rifle were supplied for the test. Each rifle was jumped once for each phase.

(3) Results:

All test rifles were jumped successfully without injury to the parachutists or damage to the weapons, except that, when jumped without the container, the stock of one T-25 was slightly cracked at the butt and one EM-2 would not fire automatically because of sand taken in the receiver on landing.

(4) Analysis:

The test rifles are of such shape and size that they can be successfully jumped by standard means. Due to the abbreviat

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nature of the test no conclusion can be drawn as to their comparative suitability in this respect nor as to their durability to withstand landing stresses. (Appendix "C",T-22).

y. Test No. 23:

(1) Purpose: To determine the suitability of test rifles for use by Armored Infantry and Armored personnel.

(2) Method:

Army Field Forces Board No. 2, in coordination with the Armored School, fired the rifles and conducted stowage tests on the following armored vehicles: Light Tanks T41 and M24, Medium Tanks M46 and M26, Armored Utility Vehicle M44.

(3) Results:

(a) All of the test rifles could be stowed properly in the five armored vehicles. Of a requirement for stowage in a total of ten places (two per vehicle), the T-25 could be stowed in 12 places, the FN in 14 and the E1-2 in 20.

(b) The folding sights of the T-25 were a disadvantage in speed-into-action through restricted openings in armored vehicles.

(c) All three weapons satisfied the requirement for emergency crew defense and security for Armored use.

(d) Armored Infantry had no requirement for a lightweight rifle differing from that of Infantry.

(4) Analysis:

(a) Armored Infantry and Armor have the same requirement for a lightweight rifle as Infantry, except for suitability for stowage, and for firing through restricted openings, in armored vehicles.

(b) For stowage and firing through restricted openings the order of suitability is E1-2, FN and T-25. All are acceptable. (Appendix "C", T-23).

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z. Test No. 24:

(1) Purpose: To determine the suitability of the sling as a means of carrying the test rifles and as a firing support.

(2) Method:

(a) The U. S. Rifle M-1, with sling, was used as a control item.

(b) Identical web slings were provided with the EM-2 and the FN rifles. The T-25 was tested with the leather sling used with the U. S. rifle M-1 inasmuch as no sling was provided with the weapon as received.

(c) During limited carrying and all firing tests the use of of the sling was observed and its suitability as a means of carrying and as a firing support noted.

(3) Results:

(a) Adequacy as firing support.

1. EM-2 and FN: The test sling was difficult to adjust properly. It did not give adequate support in either the hasty or loop sling adjustment because the wire loop catches at each end of the sling failed to hold.

2. T-25 and M-1: The M-1 sling gave adequate firing support in both the hasty and loop sling adjustments.

(b) Adequacy as a means for carrying.

1. EM-2 and FN: The test sling caused discomfort to test personnel while carrying the rifles because the thin webbing of the slings rolled.

2. T-25 and M-1: The M-1 sling proved adequate with both rifles.

(c) Due to the deficiencies in the test sling for the EM-2 and FN rifles, its use was discontinued in the course of the firing tests and the leather sling for the M-1 rifle was substituted. (Appendix "C", T-24).

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aa. Test No. 25:

(1) Purpose: To determine the length of time required to raise the sights (if folding sights are provided) and aim the rifles.

(2) Method:

(a) The U. S. M-1 rifle was used as a control item.

(b) Seven men were each required to get into the prone position from the standing position, and to aim and fire one shot at a range of 200 yards. Next, they were required to aim and fire one shot from the standing position. In each trail the time required was noted with a stop watch. Each shot was spotted and only accurate shots recorded (inaccurate shots were refired). Using each type of rifle, each man made three trials of each type firing. Using the T-25 rifle, the tests were conducted with the sights down at the start of each trial, and then repeated with the sights up. The other two test rifles and the control rifle do not have folding sights.

(3) Results:

AVERAGE TIME OF ALL MEN FOR THREE TRIALS

	Standing To Prone	Standing
EM-2	5.3 seconds	3.6 seconds
FN	4.8 seconds	3.3 seconds
M-1	5.2 seconds	3.5 seconds
T-25 (sights up)	5.5 seconds	3.8 seconds
T-25 (sights down)	6.1 seconds	4.9 seconds

Figure No. 46

(4) Analysis:

(a) From both the Prone and Standing positions the order of merit in sighting, aiming and firing the rifles is FN, M-1, EM-2, T-25 (sights up) and T-25 (sights down).

(b) The only rifle that is quicker than the U. S. M-1 Control Rifle is the FN.

(c) The time required to sight, aim and fire the T-25 with sights down is excessive.

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(d) This test is not only concerned with sighting and aiming but also with handiness. However, it is impossible to evaluate the handiness factor in the results obtained. (Appendix "C", T-25).

bb. Test No. 26:

(1) Purpose: To determine the ease of handling the rifles.

(2) Method:

(a) During all tests, particularly those involving firing, test officers observed the handling of each type of rifle.

(b) Questionnaires which referred to the ease of handling were answered by all firers.

(3) Results:

(a) Adoption of Firing Positions: There was no material difference in the ease with which the various firing positions could be adopted by men armed with any of the test rifles or the M-1 rifle. (For details, see Test No. 15).

(b) Ease and Speed of Aiming and Firing: Seven firers were required to aim and fire an accurate shot from the prone and standing positions. The order of merit was FN, M-1, EM-2 and T-25. The difference between the T-25 and the other rifles was increased if the initial raising of sights was taken into account. (For detailed results, see Test No. 25).

(c) Ease of Handling in Thick Cover: The order of merit in handling the rifles in thick cover was FN, M-1, EM-2, and T-25. This order was based largely on observations made during Test No. 17½. Although in that test the M-1 rifle became entangled in vegetation slightly less frequently than the FN, the latter was the handier of the two weapons.

(d) Magazine changing: The order of merit for ease and speed of magazine changing was: First EM-2, second FN, third T-25. (For details, see Test No. 31).

(e) Firers' Opinion on General Handiness: The opinion of firers on general handiness and ease of operating, based on questioning them at the conclusion of the tests, was:

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First FN, second EM-2, third M-1 and fourth T-25.

(f) Test Officers' Opinion on General Handiness: The opinion of the test officers on general handiness and ease of operating, based on their observations during the test was: First EM-2, second FN, third M-1, and fourth T-25.

(4) Analysis:

The comparative ease of handling the rifles was first FN, second EM-2, third M-1 and fourth T-25. (Appendix "C", T-26).

cc. Test No. 27:

(1) Purpose: To determine whether or not the rifles are suitable as Sniper Rifles.

(2) Method:

(a) To evaluate the comparative long-range accuracy of the test weapons the data obtained in Test No. 6, Phase I, for semi-automatic fire from a bench rest at 600, 800 and 1000 yards was studied.

(b) Data in "a" above pertaining to the M-1 rifle was included in the study for control purposes since the M-1 rifle, when fitted with telescopic sight, is known to be satisfactory as a sniper's rifle.

(c) The rifles were examined for feasibility of mounting telescopic sights; however, no sights actually were mounted.

(3) Results:

(a) The long-range accuracy of experts, taken from Test No. 6, Phase I, was as follows:

(Average Mean Radii in Feet)

Range	EM-2	FN	T-25	M-1
600	1.01	1.04	.77	1.04
800	1.43	1.61*	1.06	1.40
1000	2.11	Not Fired*	1.56	2.13

Figure No. 47

* Sight designed to fire only to 600 yards. Local modification of sight made it possible to obtain data at 800 yards but not at 1000 yards. However, results are not reliable.

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(b) The rifles were examined for feasibility of mounting telescopic sights. It was concluded that a telescopic sight could be mounted on all rifles:

1. EM-2:

a. The unit sight and cover could be removed and replaced by a telescopic sight and mount.

b. The standard U. S. mount could be raised 3/32" and locking adapted to the existing dovetails on the receiver.

2. FN: A special breech cover could be manufactured to incorporate a base for the telescopic sight.

3. T-25: The sight mount now used with the U. S. Sniper's Rifle M-1C could be mounted on the T-25. A cheek rest as currently used with the M-1C would be required.

(4) Analysis:

(a) There appears to be no major obstacle to mounting telescopic sights on any of the test rifles.

(b) The accuracy of all the rifles tested, when delivering semi-automatic fire at long ranges, is sufficient to make them acceptable for sniping. The order of acceptability is as follows: T-25 first, EM-2, FN and M-1 about equal. (Due to the design of the sight, the FN could not be fired at 1000 yards). (Appendix "C", T-27).

dd. Test No. 28:

(1) Purpose: To determine whether or not the bolt remains open after last round is expended from the magazine of the rifles and the action required to reload.

(2) Method:

During firing the action of the rifle on firing the last round was observed and failures recorded. Also, the action required to reload the rifles was noted.

(3) Results:

(a) Failures of the Bolt to Remain Open. Failures of the

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bolt to remain open per 1000 rounds were FN .23, EM-2 .75, and T-25 1.18.

(b) Action necessary to Reload. In order to reload the rifles, the magazine is removed and a new magazine inserted. The insertion of a new magazine automatically releases the bolt of the EM-2 (this factor makes this rifle simplest to reload). In the case of the FN the operating handle must be pulled back to release the bolt or the bolt release pushed down. With the T-25, the weapon is ready to fire automatic fire when the new magazine is inserted; in semi-automatic fire the trigger must be operated to close the breech and insert a round in the chamber.

(c) Action necessary in case the Bolt Fails to Remain Open. It was necessary, with all three test rifles, to pull back the operating handle before applying the above procedures.

(4) Analysis:

(a) In terms of failures of the bolt to remain open per 1000 rounds fired, the order of merit was FN, EM-2 and T-25.

(b) With respect to simplicity of reloading, the EM-2 was best with little choice between the FN and the T-25.

(c) All rifles were satisfactory. (Appendix "C", T-28).

cc. Test No. 29:

(1) Purpose: To determine the difficulty of assembling and disassembling the test rifles while wearing arctic hand gear.

(2) Method:

(a) Eight individuals, thoroughly familiar with the rifles, were required to field strip and assemble the test rifles while wearing Arctic Mittens and trigger finger inserts.

(b) Each individual made three trials with each type weapon.

(c) The tests were conducted in an ambient temperature of 88°F.

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(3) Results:

(a) The average time in seconds required to strip and assemble each rifle is listed below:

Rifle	Field Stripping	Assembling	Total
EM-2	26	52	78
FN	14	30	44
M-1	34	68	102
T-25	93	168	261

Figure No. 48

(b) Unusual difficulties encountered were as follows:

1. EM-2 - None

2. FN - None

3. M-1 - None

4. T-25

a. No unusual difficulties were encountered in stripping other than handling numerous parts with mittens.

b. In assembling, considerable difficulty was encountered in aligning the holes in the semi-automatic and automatic control groups in order to seat the trigger group retaining pin.

(4) Analysis:

The T-25 was the most difficult to strip and assemble taking approximately 6 times as long as the easiest weapon, the FN, and over twice as long as the control weapon, the M-1. The order of ease was as follows: First FN, second EM-2, third M-1 and fourth T-25. (Appendix "C", T-29)

ff. Test No. 30:

(1) Purpose:

(a) To determine the effect that Arctic Uniform has on the accurate delivery of fire by test personnel.

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(b) To determine the effect the Arctic Uniform has on the assumption of firing positions.

(2) Method:

(a) Insufficient time to conduct the firing as called for in "Plan of Test".

(b) Extremely high temperatures encountered made the wearing of the Arctic Uniform impracticable during extended periods of firing.

(3) Sufficient information was obtained to determine that prescribed firing positions can be assumed when wearing the Arctic Uniform. (Appendix "C", T-30).

gg. Test No. 31:

(1) Purpose: To determine the comparative suitability of magazines.

(2) Method:

(a) Empty magazines and magazines loaded with 20 rounds were weighed and weights recorded.

(b) Ease of changing magazines was observed.

(c) Malfunctions of magazines were determined by observation of magazine functioning during all firing and by inspection for serviceability of magazines at the conclusion of firing.

(3) Results:

(a) Weights of magazines in pounds:

Rifle	Empty	Loaded
EM-2	.54	1.45
FN	.49	1.40
T-25	.62	1.66

Figure No. 49

(b) No difficulty was encountered in changing magazines with any type rifle, although both the T-25 and FN required tilting for insertion of magazine. The easiest to change was the EM-2 magazine, followed by the FN and the T-25 in that order. Lack of a magazine guide was apparent on all three weapons.

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(c) Malfunctions of, and damage to, magazines occuring during all firing were as follows:

MALFUNCTIONS AND DAMAGE

Type	No. Magazines Used	No. Rounds Fired	No. Magazines Unserviceable	Comments
EM-2	106	56,815	4	Damaged in use.
FN	84	54,800	1	Damaged in use.
T-25:				
Standard	56			3 damaged in use.
X-Type	47	61,012	17	14 short spring or set developed in spring.

Figure No. 50

(d) Magazines were not expendable.

(4) Analysis:

(a) The EM-2 and FN magazines are satisfactory from the point of view of durability and ease of changing magazines. The T-25 standard and X-Type are unsatisfactory.

(b) During the test it was not possible to determine what malfunctions of the rifles were due to the magazines.

(c) The magazines of the EM-2 and T-25 are undesirably heavy.

hh. Test No. 32:

(1) Purpose: To compare the kick of the test rifles when firing test ammunition and grenades.

(2) Method:

The test was based on observation of firers throughout all tests, and questioning of firers periodically.

(3) Results:

(a) With ball ammunition, the severity of kick was assessed in the following order: T-25, M-1, FN and EM-2. In the case of the T-25, the kick was considered by some firers to be excessive and, in some cases, to cause discomfort and bruising.

(b) When firing grenades, the severity of kick was assessed in the following order: M-1, T-25, FN and EM-2. In no case was the kick considered excessive for this type of firing.

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(4) Analysis:

(a) The kick of the T-25 is the most severe of the test rifles. The kick of the EM-2 is light and is the least of the three test rifles. The kick of the T-25 is excessive.

(b) The kicks of the EM-2 and the FN are considerably less than that of the M-1 and are in no way excessive.

(c) The severity of kicks of the test rifles in launching grenades are not excessive for this type of firing. (Appendix "C", T-32).

ii. Test No. 33:

(1) Purpose: To determine the comparative effect of firing test rifles on using personnel.

(2) Method:

(a) During the conduct of all firing tests the degree of fatigue of firers was noted.

(b) Firers were interviewed periodically on the effects of firing.

(3) Results:

(a) Recoil and other functional operations:

1. T-25: Heavy kick and disadvantages associated with firing from the open bolt.

2. FN: Vibration of the butt.

3. EM-2: Difficulties associated with trigger design.

4. The FN is the most desirable of the three rifles in respect to recoil and functional operations.

5. With all rifles the handgrip becomes too hot to hold after about 180 rounds of semi-automatic or automatic fire.

(b) Comfort of firing positions: Other than the shortness of the FN butt, all rifles are satisfactory.

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(c) Shape of Stock: No shortcomings of significance with any of the test rifles.

(d) Smoke, Dust and Gases:

1. T-25: Minor troubles relating to each element.

2. EM-2: Gases escape rearwards on ejection.

3. FN: No adverse features.

(e) Noise and Blast:

1. T-25: Excessive report affecting both firer and those adjacent.

2. EM-2: Bad angle of ejection.

3. FN: Bad angle of ejection but not as bad as the EM-2.

(f) Ease of Manual Operations:

1. T-25: Complicated trigger and open-bolt operation, delay in magazine changing, operation of safety lever stiff sight adjustment, and overheating of operating handle. This rifle was considered to be the least suitable by most firers in case of manual operations.

2. FN: Magazine catch hard to locate, variable stiffness of change lever. This rifle was considered to be the most suitable by most firers in case of manual operations.

3. EM-2: Inconsistent trigger action, overheating of trigger and cocking handle after short periods of sustained firing, stiff action of cocking handle during initial unlocking. It was noteworthy for ease of changing magazines and sight adjustment.

(4) Analysis:

(a) In comparative effect on using personnel the order of merit of the rifles is FN, EM-2 and T-25. The FN is clearly superior to the EM-2, and the EM-2 is clearly superior to the T-25.

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(b) The overheating factor in all three rifles is excessive and especially so in the EM-2 in which the trigger also overheats. The acceptability of all rifles is marginal in this respect.

(c) The undesirably heavy kick and excessive blast of the T-25 makes its acceptability even more marginal. (Appendix "C", T-33).

jj. Test No. 34:

(1) Purpose: To determine the malfunctions and replacement of parts of test rifles and the causes therefor under the conditions encountered during tests.

(2) Method: Throughout the conduct of all tests a record or "gun book" was maintained for each rifle showing:

(a) Number of rounds fired.

(b) Replacement of parts.

(c) Malfunctions or failures and causes therefor.

(3) Results:

(a) MALFUNCTIONS

Rifle	Type of Fire	Rounds Fired	Malfunctions Per 1000 Rounds	Average SA & A
EM-2	Semi-automatic	20,064	5.73	4.54
EM-2	Automatic	36,751	3.89	
FN	Semi-automatic	19,923	5.72	6.97
FN	Automatic	34,877	7.68	
M-1	Semi-automatic	16,684	3.84	- -
M-1	Automatic	- - -	- -	- -
T-25	Semi-automatic	22,739	17.63	10.93
T-25	Automatic	38,273	6.97	

Figure No. 51

(b) Total breakage or parts requiring replacement:

EM-2	FN	M-1	T-25
86	44	8	67

Figure No. 52

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(c) The causes of many breakages and stoppages were eliminated during the tests.

(d) Causes of malfunctions, breakages and replacement of parts: The causes are being studied by the Technical services.

(4) Analysis:

(a) The order of merit based on stoppages per 1000 rounds in all firing is EM-2 (4.54), FN (6.97) and the T-25 (10.93).

(b) The order of merit in total number of breakages and parts requiring replacement is FN (44), T-25 (67) and EM-2 (86).

(c) None of the test weapons is at present as reliable as the M-1, but as development weapons, malfunctions and breakage are not considered excessive. (Appendix "C", T-34).

kk. Test No. 35:

(1) Purpose: To determine wherein the tested rifles meet and or fail to meet the established military characteristics for lightweight rifle.

(2) Method:

A study was made of the test rifles together with results of test in comparison to the established military characteristics for the lightweight rifle.

(3) Results:

The major failure to meet military characteristics for all test weapons is the lack of accuracy in automatic fire without bipod rest and to a lesser extent, with bipod rest. For detailed comparison with military characteristics see Appendix "C", T-35.

ll. Test No. 36:

(1) Purpose: Assuming the test rifles are satisfactory for adoption as rifles, to determine their suitability also to replace the U. S. carbine, sub-machine gun and automatic rifle and the U. K. Sten and Bren guns.

(2) Method:

The results of the rifle tests were compared with the results of earlier tests of the standard U. S. weapons and with data taken from field manuals and technical manuals. For the

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purpose of the study it was assumed that the U. K. weapons are generally similar in performance to the U. S. standard weapons. Where they are deemed suitable to replace U. S. weapons they are assumed to be suitable to replace comparable U. K. weapons.

(3) Results:

(a) Suitability to Replace the Carbine:

1. The carbine is principally an individual, light defensive weapon. Its principal characteristics are its light weight, both of weapon and ammunition, and its handiness for carrying.

2.

	Carbine	EM-2	FN	T-25
Weight#	5.25	8.03	8.57	7.88
Length	35.5"	34.4"	38.75"	43.0"

3. Accuracy in Automatic Fire: Within the effective range of the carbine the accuracy of the carbine and the test rifles is generally equal.

(b) Suitability to Replace the Sub-machine Gun and Sten Gun:

1. In World War II the sub-machine gun was used widely in Infantry as a defensive weapon for platoon and squad leaders. In armored units it was used as armament for tank crews. Today the sub-machine gun is standard only for tank crews, both Infantry and Armor.

2.

	SMG	EM-2	FN	T-25
Weight#	7.87	8.03	8.57	7.88
Length	29.2"	34.4"	38.75"	43.0"

SMG stock folded - 22.2"

3. Accuracy in Automatic Fire: At the close ranges at which a sub-machine gun normally is fired, the accuracy of the sub-machine gun M3A1 and the test rifles is generally equal.

4. All of the test rifles have been found acceptable for use by crews of armored vehicles in the order of preference EM-2, FN, T-25. (Test No. 23).

(c) Suitability to Replace the Automatic Rifle and Bren Gun:

1. The automatic rifle was developed to bring within the squad as much of the accuracy, range, and sustained

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automatic fire of the light machine gun as possible in a weapon fully transportable and operable by one man.

2. Accuracy in Automatic Fire: At the ranges tested (100 and 200 yards) the BAR was approximately twice as accurate as the test rifles. The T-25 with heavy barrel was 25 to 30 percent more accurate than the test rifles but was considerably less accurate than the BAR and Bren.

3. Maximum Sustained Rate and Most Effective Rate: The maximum sustained rate and the most effective rate of the test rifles is the same - 40 to 60 RPM for 5 minutes, provided the hands are protected. The maximum sustained rate of the BAR is 40 - 60 rounds per minute indefinitely and its most effective rate is 120 - 150 rounds per minute.

(4) Analysis:

(a) Any of the test rifles when modified in accordance with Appendix "E" could replace the carbine.

(b) Any of the test rifles when modified in accordance with Appendix "E" are satisfactory to replace the sub-machine gun M3A1 and Sten gun as armament for crews of armored vehicles in the order of preference EM-2, FN, T-25. Considered as a close combat weapon for general Infantry use, the order of preference (based primarily on length) would be EM-2 and FN and T-25.

(c) In their present development, because of insufficient automatic fire accuracy and insufficient sustained fire capability, none of the test weapons are capable of replacing the BAR or the Bren gun.

Limited tests indicate that the T-25 with bipod and heavy barrel (the only test weapon so equipped) has insufficient accuracy in automatic fire to replace the BAR or the Bren gun. Its sustained fire capability was not tested.

mm. Ammunition Test No. A-1:

(1) Purpose: To determine the comparative accuracy of test ammunition.

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(2) Method:

Suitable comparison of ammunition could not be made at this Board. The accuracy was determined at Aberdeen Proving Ground. See paragraph 6e(4) below - page 74.

nn. Ammunition Test No. A-2:

(1) Purpose: To determine the comparative functioning of test ammunition.

(2) Method:

(a) During all tests all malfunctions of weapons and the causes therefor were carefully noted and recorded.

(b) All brass was examined for malformation, split cartridge cases and blown primers.

(3) Results:

(a) Only four instances of malfunctions during firing attributable to the ammunition occurred:

1. 2 rounds, Caliber .280 Ball, fired from the EM-2 rifle resulted in ruptured cartridges.

2. The Caliber .30 T-103 observing rounds had insufficient power for complete recoil of the T-25 rifle.

(b) All other malfunctioning of weapons apparently was due to the weapons themselves. Details of mechanical failure and malfunctioning are in rifle Test No. 34.

(c) One misfire occurred in .280 caliber over 200,000 rounds of firing. No hangfires or blowbacks occurred.

(d) Periodic inspections by test officers of rifle bores with a borescope revealed heavy metal fouling in the EM-2 and T-25 and light metal fouling in the FN.

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(c) 1. Heavy carbon fouling accumulated in the piston of the T-25 requiring the piston to be reamed out after each 200 rounds. On several occasions the gas plug stuck requiring considerable effort for removal. On several occassions the piston also stuck and had to be hammered out of the gas cylinder.

2. The piston and gas plug of the FN stuck in a similar manner to the T-25 but with less frequency.

(4) Analysis:

All test rounds are equally satisfactory in respect to the effect on functioning of the weapons with the exception of the caliber .30 T-103 observing round which had insufficient power for complete recoil. (Appendix "C", Ammo Test No. 2).

oo. Ammunition Test No. A-3:

(1) Purpose: To determine the suitability of tracer and observing ammunition for combat use.

(2) Method:

(a) Functioning of tracer rounds:

1. The visibility of tracer ammunition was determined by firing against a light background, dark background an bright sky. Observers were stationed at the gun position and at 100 yards to the right and to the lef of the gun position.

2. The visibility of tracer ammunition from the target area was determined by stationary observers forward of the gun at ranges from 100 to 1000 yards at an angle of 5° from the line of fire during daylight, dusk, and night firing.

3. Characteristics and malfunctions of all tracer were noted.

(b) Functioning of observing rounds. The functioning was determined by firing into various types of soil and vegetation. German 7.92mm observing ammunition was used as a control item.

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(c) Target designation. The effectiveness of tracer and observing ammunition in designating targets was determin by firing from a single firing point at ranges of 50 to 1000 yards, under bright sunlight, overcast sky at dusk, at night, and at night under 60mm mortar illumination. The observers were stationed at the firing point and at 100 yards to the right and left of the firing point on line with the gun.

(3) Results:

(a) Functioning of tracer rounds:

1. Bright sky and sun - no tracers were visible.

2. Against brush, trees, and at dusk and at night visibility of all types of tracer ammunition was satisfactory.

3. The color of the caliber .280 tracer made it easier to see in daylight than the others.

4. In daylight from the target area, only one observer saw any tracer. He saw only one round and from it he could not locate the gun position.

5. At dusk and at night all observers forward of the gun could see all tracers. The observers could not, however, locate the gun position.

6. Characteristics of tracer ammunition as reported by observers:

Type	Color	Ignition point Distance from muzzle	Burn out Point
M-1	bright orange	25-50 yards	950 yards
Cal. .280	bright rose	50-100 yards	over 1000 yards
T-102	orange red	75 yards	1000 yards

Figure No. 53

7. An average of two rounds out of ten of the M-1 tracer failed to function. No failures in the other two types were noted.

(b) Functioning of observing rounds.

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1. The functioning of all test observing ammunition was erratic, particularly at shorter ranges.

2. Most failures to function occurred with the T-103, next with the caliber .280, and least with the German 7.92mm.

(c) Target Designation.

1. Tracer.

a. During daylight firing no targets could be designated at ranges less than 100 yards nor when firing into the sun. At longer ranges all rounds that functioned could be seen from the firing point. The visibility from the flanks was somewhat less in the case of the M-1 tracer and the T-102. There were no failures to function with the test ammunition that could be ascertained.

b. At dusk, after dark and under flares the test tracer ammunition (T-102 and .280) was satisfactory for designating targets at 75 yards or more, and the caliber .30 M-1 tracer was satisfactory at 100 yards or more.

2. Observing ammunition.

a. Firing of observing ammunition gave five results:

(i) Failure to function. No target recognition possible.

(ii) Partial functioning, fiving off only a small wisp of smoke or small flash. Target recognition not reliable.

(iii) Ricochet resulting in air burst. This was a common occurrence at 200 yards or less on flat terrain. Target designation doubtful.

(iv) Complete functioning. Target designation and observation of strike excellent.

(v) The caliber .30 observing ammunition had insufficient power to recoil the rifle.

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b. At short ranges (200 yards or less) at dusk and at night under illumination, the flash occurring on impact tended to mislead as to the location of the target. At longer ranges (250 yards or more) the smoke from all functioning rounds could be readily observed to the limit of visibility.

c. At night all observers could see the flash of complete functioning rounds but none could locate point of impact.

(4) Analysis:

(a) The color and ignition point of the trace of the .280 tracer made it easier to see than the other tracer rounds in daylight.

(b) All test tracer rounds were easy to see at night.

(c) The functioning of the test observing rounds was erratic but the .280 was slightly better than the caliber .30. In addition the caliber .30 round would not recoil the rifle.

(d) When the observing round functioned, target designation was better at all ranges than with tracer except at dusk and at night. (Appendix "C", Ammunition Test No. 3).

pp. Ammunition Test No. A-4: Omitted

qq. Ammunition Test No. A-5:

(1) Purpose: To determine the comparative incendiary effect of API, observing and tracer ammunition.

(2) Method:

(a) The following types of ammunition were used:

1. Caliber .280:

a. API (23A)

b. Tracer (32A)

c. Observing.

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2. Caliber .30:

a. API (T-101)

b. Tracer (T-102)

c. Observing (T-103)

d. API (FA40)

e. Tracer (M25)

(b) Rounds of each type were fired into wood, straw, baled cardboard, baled paper, ammunition containers, canvas and rubberized material, loose paper behind wood, cloth behind wood, gasoline in 5-gallon can in the open, gasoline in 5-gallon can in a truck and gasoline in container when part of gas had leaked on the ground.

(c) Rounds were fired at gasoline targets until one hit was obtained.

(d) Other targets were fired at until five hits were obtained on the target or until ignition occurred.

(3) Results:

(a) All firing failed to ignite the following materials:

1. Tightly baled cardboard.

2. Tightly baled paper.

3. Ammunition containers and boxes.

4. Loosely piled straw.

5. Baled canvas or rubberized material.

6. Loose cotton rags in a wooden box.

7. Loose paper behind a pine board.

(b) Straw behind boards was ignited by both caliber .30 API T-101 and caliber .30 Tracer T-102, but no ignition occurred on refiring.

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(c) Caliber .280 Tracer ignited gasoline in a can in the open. No other round had any incendiary effect on this target.

(d) A five gallon can of gasoline with gasoline spilled on the ground around it was ignited only by caliber .280 Tracer 32A, caliber .280 Observing and caliber .30 Observing.

(e) Ignition when firing at a full gasoline can in a truck cab occurred with the following types of ammunition:

Ammunition	Round on which ignition occurred
.30 API FA-40	3rd
.30 API FA-40	3rd
.30 API T-101	5th
.280 API 23A	2nd
.280 API 23A	2nd
.280 API 23A	4th
.280 Tracer 32A	2nd
.280 Tracer 32A	2nd
.280 Tracer 32A	5th

(4) Analysis:

(a) The incendiary effect of all rounds against all targets other than gasoline in containers was negligible.

(b) The incendiary effect of the .280 tracer and API were equal against gasoline cans in the cab of a truck and superior to the caliber .30 API.

(c) The .280 tracer was superior to all other rounds in igniting gasoline cans in the open.

(d) The value of the incendiary effect of both the caliber .280 API and caliber .30 API are doubtful. (Appendix "C", Ammunition T-5).

rr. Ammunition Test No. A-6: Omitted

See Rifle Test No. 18

ss. Ammunition Test No. A-7: Omitted

See Rifle Test No. 18

tt. Ammunition Test No. A-8: Omitted

See Ammunition Test No. 2.

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uu. Ammunition Test No. A-9: Omitted

See Ammunition Test No. 2 and Rifle Test No. 34.

vv. Ammunition Test No. A-10: Omitted

ww. Ammunition Test No. A-11:

(1) Purpose: To compare the results of test with established military characteristics of small arms ammunition.

(2) Method:

Military Characteristics of Small Arms Ammunition as established by Army Field Forces Board No. 3 Project No. 2256 and Appendix M to British War Office Policy Statement No. 9 was made and tabulated.

(3) Results:

The results of test obtained in the APG test of Ammunition for Lightweight Rifles and at Army Field Forces Board No. 3 were compared to established military characteristics and tabulated. See tabulation in Appendix "C", Ammunition Test No. 11.

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6. Discussion:

a. The tests at Aberdeen Proving Ground and Fort Benning are both considered in this discussion and in the conclusions and recommendations that follow.

b. In this test the many variables that were present made for a most unusual test. The five tested items have little common ground for comparison. However, as the test progressed the good and bad qualities of the tested items became apparent and a sound comparison is possible.

c. In grouping the five tested items for comparison there are two groups of items: one; the ammunition in .280 and .30 caliber and two; the three rifles, one in .30 caliber and two in .280 caliber.

d. Ammunition:

(1) The test ball cartridges, mild steel core, are the rounds discussed unless specific mention of type is made.

(a) The .280 caliber bullet weighs 139 grains and is propelled at a velocity, recorded at 78' from the muzzle, of 2270 feet per second. The muzzle energy of this bullet is 1681 foot pounds.

(b) The .30 caliber bullet weighs 136 grains and is propelled at a velocity, recorded at 78' from the muzzle, of 2770 feet per second. The muzzle energy of this bullet is 2457 foot pounds.

(c) Translated into recoil in the same rifles it is obvious that the round producing the greater muzzle energy will produce the greater recoil.

(2) The ballistic coefficient of the .280 round is better than that of the .30 caliber round. Translated into flight characteristics better stability is obtained from the .280 bullet, particularly at longer ranges. However, the .30 caliber round has flatter trajectory. The maximum ordinate of the trajectory at 700 yards is 5.6 feet as opposed to ~~8.6~~ 7.2 feet for the .280 round.

(3) The accuracy as determined by a Mann barrel in terms of mean radius at 600 yards for the .30 caliber bullet is 5.4" while that of the .280 bullet is 9.60". At ranges above 1000 yards this difference in accuracy would tend to vanish because of the better stability of the .280 round.

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(4) In attempting to compare the wounding or stopping power the report of the Medical Division, Chemical Corps, "Wound Ballistics of .280 Cal. U. K. and .30 Cal. U. S. Bullets", was studied. In addition a conference was held on 19 September 1950 with Dr. Zuckerman, (Scientific Advisor to the British Cabinet), Dr. Robertson (Weapons Evaluation Group) and Dr. Herget (Medical Division, Army Chemical Center.)

(a) Resulting from this conference and study it is determined that the higher velocity T-65 .30 caliber round does more damage than the lower velocity .280 round but the significance is slight because the .280 round is well above the marginal power required.

(b) Of the three factors that determine the transient cavity, velocity, cross sectional area, and shape, velocity is the most important.

(c) Dr. Hergets study indicated that the superior quality of the wounding and stopping power (as measured by the transient cavity of the wound) of the T-65 .30 caliber over the .280 caliber was due to the higher velocity of the T-65 .30 caliber round.

(5) In the penetration of armor, helmets, and other items at ranges less than 1000 yards the T-65 .30 caliber is superior; but again because of the better ballistic coefficient of .280 round, the penetrating power of the two rounds merge at this range and at longer range the .280 round surpasses the T-65 .30 caliber round. At 1200 yards both rounds give 100% penetration on helmets. At 1000 yards the .280 defeats body armor 70% of the time while the T-65 .30 caliber defeats body armor 60% of the time.

(6) Physically, the complete rounds of ammunition compare as follows: The .280 round is 2.53" long, weighs 320 grains or .0455 pounds; the .30 caliber round is 2.78" long, weighs 364 grains or .064 pounds. Translated into loads the soldier carried and expressed to the nearest fraction the .280 round has 8/9th the bulk and 8/9th the weight of the T-65 .30 caliber round.

(7) The T-65 .30 caliber round produces more flash and considerably more smoke than does the .280 round. However, neither round is smokeless nor flashless.

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(8) (a) In special types of ammunition produced, both the observing and tracer rounds in .280 caliber are superior to the T-65 .30 caliber. The .280 caliber tracer produces a longer and more easily visible trace.

(b) The observing round gives acceptable performance (60%) while the .30 caliber performance is unacceptable (20%).

(c) In the API round, the .280 caliber gives better incendiary effect than the .30 caliber round, but the latter gives better penetration except at ranges under 100 yards. In the Fort Benning tests the incendiary qualities of neither round were good.

(9) The requirement that the test ammunition be useable both in US and UK standard rifles and machine guns was shown in the Demonstration of Converted Weapons (See Appendix "K"). Both the .280 and .30 caliber rounds will function in machine guns and automatic rifles.

c. Rifles: In consideration of the performance of the rifles a comparison is made of their characteristics. To assist in this comparison and give weight to the more important factors the military characteristics are arranged into three groups in order of importance:

(1) Group 1.

(a) Accuracy in semi-automatic fire (rifle and ammunition combined).

(b) Reliability under normal conditions of field usage.

(c) The durability of the weapons and their ability to withstand normal hard usage.

(d) The basic weight of the rifle and its weight when combined with the combat load of ammunition for the individual soldier.

(e) The sustained fire capabilities of the rifles, that is, the ability of the rifles to maintain a volume of accurate fire over a long period of time.

(2) Group 2.

(a) Ease of field maintenance.

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(b) Accuracy in automatic fire (rifle and ammunition combined).

(c) The ability of the rifle to withstand hard usage under abnormal conditions.

(d) The handiness of the rifles under various conditions of combat and ease of assuming firing positions.

(e) Combat manageability and effect on firers.

(f) The automatic cyclic rates of the rifle and ammunition combined.

(3) Group 3. The third group consists of all requirements not listed in groups 1 and 2 above, including suitability of accessories, etc.

(4) Group 1.

(a) Accuracy of semi-automatic fire. The following accuracies obtained at Aberdeen Proving Ground and Fort Benning are presented as a matter of interest.

(600 yards mean radii in inches)

Round	Mann Barrel	Rifle	Range Accuracy at Benning	Difference
.280	9.76	EM-2	12	2.24
.280	9.76	FN	12.5	2.74
Cal. .30	5.4	T-25	9.2	3.84

Figure No. 54

The above information would seem to indicate that the basic accuracy of the rifles are comparable. In any case, their accuracy while not meeting military characteristics are not less than that of the M-1 rifle firing M-2 ball ammunition.

(b) Reliability under normal conditions of field usage. In reliability under normal conditions, based on stoppages or malfunctions that occurred in firing, the order of merit is: EM-2 (258); FN (382); T-25 (667). While it would appear that the number of malfunctions is excessive, modifications of minor nature were made from time to time and reliability improved as the test progressed. At the end of the test, test records indicated that reliability of the test weapons approached that of the M-1 and all were approximately equal.

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(c) Durability. Under comparative durability based on parts broken during the firing tests expressed in order of merit is: FN (44); T-25 (67); EM-2 (86). Initially the difference in durability of the test weapons to the M-1 rifle was considerable, however, as tests progressed and minor modifications made test records show that durability improved to the extent that it approaches that of the M-1 rifle. It must be remembered that the M-1 rifles does not fire automatic fire and hence fired less rounds. Further, at the end of the tests the durability of the FN was acceptable based on firing tests. However, none of the test rifles were strong enough to withstand the hard usage of bayonet fighting. All stocks or butts suffered damage in the butt stroke. The rifles were not tested for their ability to continue to function for long periods when care and cleaning were neglected but this Board can be foresee no obstacle in improving the rifles to achieve acceptable durability.

(d) Weight. The basic weight of none of the rifles meets the requirement of the US military characteristics (7 pounds). Only the T-25 meets the requirement of the British military characteristics (8 pounds). Weight of rifle and ammunition, including sling, bayonet, scabbard, bipod, grenade launcher and 200 rounds of ammunition loaded into magazines, and of the ammunition alone are:

Rifle	Total	Ammunition only in magazines
EM-2	25.51 lbs	14.5 lbs
FN	25.27 lbs	13.98 lbs
T-25	26.90 lbs	16.58 lbs

(e) Sustained fire capabilities. All rifles became too hot to handle at the forearm after about 180 rounds. After approximately the same number of rounds the trigger of the EM-2 heats to the extent that protection is required for the trigger finger. The T-25 heated until the woodwork was completely burned away in comparative performance tests. The FN is definitely superior to the other two rifles.

(5) Group 2.

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(a) Ease of field maintenance. Of all rifles tested only the FN could be maintained in the field without the use of a special tool, the only tool required for field stripping and maintenance was a cartridge. Further, the FN's simplicity of design and ease of stripping and assembling make it possible to replace parts much quicker than for either of the other two rifles. The order of merit in ease of field maintenance is: FN, EM-2 and T-25. The degree of superiority of the FN and EM-2 over the T-25 is marked. Because of the undesirable difficulty encountered in field stripping and assembling the T-25, it is unsatisfactory.

(b) Automatic accuracy. The automatic accuracy of none of the rifles either with or without bipod meet the requirements stated in the military characteristics. With the bipod the T-25 is superior to the FN and EM-2 which are about equal. This order of merit follows that previously obtained in semi-automatic fire. Without the bipod the EM-2 and FN are far superior to the T-25 and are about equal. This lack of accuracy in the T-25 is believed to be due to its high cyclic rate, and power of the ammunition. In overall consideration of the requirement of the military characteristics against performance it is considered that the military characteristics for a weapon of this type are too stringent and cannot be met unless new principles are developed. When compared to the BAR and Bren, none of the test rifles approach the performance of those weapons, and are not considered acceptable replacements.

(c) The cyclic rate of fire of the EM-2 and FN, while considered high, are acceptable and about equal. The T-25 cyclic rate is much higher than the other two above rifles and is unacceptable. The Board believes that a slower cyclic rate of about 350 rounds per minute or less is desirable. If this can be accomplished without causing excessive dispersion.

(d) Hard usage tests under abnormal conditions conducted at Aberdeen indicate that the superiority of the EM-2 to the other two rifles is marked and that the performance of the T-25 and FN is unsatisfactory. These results are partly confirmed in tests at Fort Benning.

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(c) Handiness in firing positions, etc. The test rifles are all very handy and are considered suitable for use by airborne troops and armored personnel.

(f) Combat manageability. All rifles in combat firing and in the positions used in combat firing were easily managed. The accuracy in combat firing confirmed the results obtained in semi-automatic and automatic accuracy.

(g) Effect on firers. The kick of the T-25 is objectionable and causes discomfort to firers. The sharp report from the rifle is extremely annoying to adjacent firers who are less than five yards to the flank of the muzzle. The ejection of the EM-2 frequently strikes adjacent firers up to five yards and cuases annoyance. The trigger of the EM-2 is hard to operate requiring unnecessary effort on the part of the firer. Occasional particles of unburned powder from the EM-2 strike the firer in the face. The stock of the FN is too short and causes discomfort to all but the shortest firers. The ejection of the FN is to the right and strikes adjacent firers up to 3 yards. The Board believes that the T-25 would impose a greater training problem than the other two test rifles in that more time would be required to overcome the recruits fear of the kick and blast.

(6) Group 3.

(a) Attachments. All rifles can be fired with all muzzle attachments. However, the attachment of the grenade launcher and the bayonet to the T-25 results in an excessive change in the center of impact from that obtained without the attachments.

(b) Sights. While the sights are all useable in their present form, ultimately a modification of one of the present sights or another sight must be adapted to the rifle accepted. Consideration of the sights should be divorced from comparison of the test rifles.

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f. As a result of user tests described in this report it is apparent that some of the military characteristics are conflicting, and that not all of them can be met in the foreseeable future.

(1) It is questionable whether a rifle weighing only seven or even eight pounds can have the necessary durability regardless of whether it fires automatic or semi-automatic fire.

(2) Automatic fire imposes several disadvantages. First, the amount of heat generated makes the weapon difficult to handle when firing or in bayonet fighting. Secondly, extra spare parts must be carried displacing some of the ammunition load of the rifleman. Thirdly, excessive dispersion makes automatic fire from a hand held weapon extremely unprofitable except at very short ranges.

7. Conclusions:

a. That the T-65 Cal. .30 is not satisfactory because of its excessive recoil, blast, flash and smoke.

b. That the Cal. .280 is not satisfactory because of its comparatively high trajectory.

c. That of the two basic type rounds submitted for test the British caliber .280 is preferred.

d. That none of the three test rifles is acceptable in its present form.

e. That the FN will be acceptable for comparatively early use when modified in accordance with Appendix "E".

f. That the EM-2 and T-25 require considerable further development and are not acceptable in their present form. Of these two the EM-2 is preferred.

g. That saving in weight shows more promise of being accomplished in ammunition and magazine development than in rifle development.

h. That military characteristics (US and UK) for light rifles and ammunition require revision

(1) To secure agreement,

(2) To permit compromises in design in order to produce the optimum performance,

(3) to set standards which can be achieved for interim use.

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8. Recommendations:

a. That development of small arms ammunition, lightweight rifles and machine guns be carried out in the .280 caliber.

b. That if urgency exists to adopt a rifle and ammunition immediately that the FN rifle and the .280 cartridge be modified as shown in Appendix "E" and be tested.

E. W. D. WESTERN
Brigadier, British Army
War Office Representative

BURTON L. LUCAS
Colonel, Infantry
President

~~1 Incl~~
~~(Coordination)~~
~~and~~
APPENDICES
A. Copy of Directive
B. Characteristics Sheet.
C. Details of Test
D. Analysis of test results. (Omitted)
E. Deficiencies and Suggested Modifications
F. Photographs.
G. Drawings (Omitted)
H. Service Test Questionnaire (Omitted)
I. Training Aids (Omitted).
K. Report of Converted Weapons Demonstration.

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APPENDIX A - COPY OF DIRECTIVE

APPENDIX B - CHARACTERISTICS

APPENDIX C - DETAILS OF TESTS

Test No. 1 - To determine the physical characteristics of the Test Rifles.

Test No. 2 - To determine that part of the combat load attributable solely to the tested rifle, accessories and ammunition imposed on the individual soldier.

Test No. 3 - To determine the comparative ease of assembly and disassembly including difficulty of training therein of the tested rifles.

Test No. 4 - To determine the ease of care and cleaning and the equipment required for field maintenance.

Test No. 5 - To determine the stability, durability and suitability of sights and whether or not sights have a battle sight adjustment.

Test No. 6 - To determine the comparative accuracy of the test rifles when fired semi-automatically.

Test No. 7 - To determine comparative accuracy of the rifles when firing automatic fire from a prone position with a muzzle and elbow rest with cool and hot barrels.

Test No. 8 - To determine the comparative automatic fire accuracy of the test rifles unsupported by artificial rests.

Test No. 9 - To determine the average number of hits obtained under simulated combat conditions with the rifles.

Test No. 10 - To determine the comparative accuracy of the test rifles at the maximum rate of semi-automatic and automatic aimed fire.

Test No. 11 - To determine the most effective semi-automatic and automatic rate of fire of the test rifles.

Test No. 12 - To determine the approximate semi-automatic and automatic sustained fire capabilities of the test rifles.

Test No. 13 - To determine the comparative effectiveness of a rifle squad armed with the test rifles and as currently armed, when firing from a fixed position at 250 yards.

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Test No. 13½ - To determine the suitability of muzzle attachments for performing designed functions.

Test No. 14 - To determine the suitability of the tested rifles for bayonet fighting.

Test No. 15 - To determine the facility and ease with which currently accepted firing positions can be assumed by men of varied conformations including left-handed men.

Test No. 16 - To determine the dependability and adequacy of the safety devices of the test rifles.

Test No. 17 - To determine suitability of the test rifles for launching grenades and adaptability for launching rifle grenades from currently accepted firing positions.

Test No. 17½ - To determine if the rifles are strong enough to withstand hard usage of field service.

Test No. 18 - To determine comparative visibility of the muzzle flash of the test rifles during darkness and of the smoke during daylight.

Test No. 19 - To determine the efficiency of the test rifles in semi-automatic and automatic fire as assault weapons.

Test No. 20 - To determine the average number of hits obtained per pound of ammunition expended under simulated combat conditions.

Test No. 21 - To determine the facility with which the rifles can be reloaded while moving over uneven terrain under conditions approximating those of the assault in combat. (Omitted)

Test No. 22 - To determine the suitability of the rifles for Airborne use.

Test No. 23 - To determine the suitability of test rifles for use by Armored Infantry and Armored personnel.

Test No. 24 - To determine the suitability of the sling as a means of carrying the test rifles and as a firing support.

Test No. 25 - To determine the length of time required to raise the sights, and aim the rifles (If folding sights are provided).

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Test No. 26 - To determine the ease of handling the rifle.

Test No. 27 - To determine whether or not the rifles are suitable as sniper rifles.

Test No. 28 - To determine whether or not the bolt remains open after the last round is expended from the magazine of the rifles and the action required to reload.

Test No. 29 - To determine the difficulty of assembling and disassembling the test rifles while wearing the Arctic hand gear.

Test No. 30 -

a. To determine the effect that the Arctic Uniform has on the accurate delivery of fire by test personnel.

b. To determine the effect the Arctic Uniform has on the assumption of firing positions.

Test No. 31 - To determine the comparable suitability of magazines.

Test No. 32 - To compare the kick of the test rifles when firing test ammunition and grenades.

Test No. 33 - To determine the comparative effect of firing test rifles on using personnel.

Test No. 34 - To determine the malfunctions and replacement of parts of test rifles and the causes therefor under the conditions encountered during tests.

Test No. 35 - To determine wherein the tested rifles meet and/or fail to meet the established military characteristics for lightweight rifles.

Test No. 36 - Assuming the test rifles are satisfactory for adoption as rifles, to determine their suitability also to replace the U. S. Carbine, sub-machine gun, and automatic rifle and the U. K. Sten and Bren guns.

Ammunition Test No. 1 - To determine the comparative accuracy of Test Ammunition as compared with Standard Ammunition.

Ammunition Test No. 2 - To test the comparative functioning of test ammunition.

Ammunition Test No. 3 - To determine the suitability of tracer and observing ammunition for combat.

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Ammunition Test No. 4 - To determine the rate of corrosion caused by Test Ammunition compared with corrosion caused by Standard Ammunition. (Omitted)

Ammunition Test No. 5 - To determine the comparative incendiary effect of API, observing and tracer ammunition.

Ammunition Test No. 6 - To compare the smoke (color and density from both muzzle and breech) by the Test Ammunition and Standard Ammunition under various weather conditions and against varied background. (Omitted - See Rifle Test No. 18).

Ammunition Test No. 7 - To test the comparative flash produced by Test Standard Ammunition. (Omitted - See Rifle Test No. 18).

Ammunition Test No. 8 - To test the comparative reliability of Test Ammunition and Standard Ammunition (misfires, hangfires, blowbacks, etc.). (Omitte See Ammunition Test No. 2).

Ammunition Test No. 9 - To record all malfunctions of ammunition and weapons and the causes therefor. (Omitted, See Ammunition Test No. 2 and Rifle Test No. 34).

Ammunition Test No. 10 - To determine the suitability of the ammunition for airdrop in standard containers. (Omitted)

Ammunition Test No. 11 - To compare the results of test with established military characteristics of small arms ammunition.

APPENDIX D - ANALYSIS OF TEST RESULTS (Omitted)

APPENDIX E - DEFICIENCIES AND SUGGESTED MODIFICATIONS.

APPENDIX F - PHOTOGRAPHS

APPENDIX G - DRAWING (Omitted)

APPENDIX H - SERVICE TEST QUESTIONNAIRE (Omitted)

APPENDIX I - TRAINING AIDS (Omitted)

APPENDIX K - REPORT OF CONVERTED WEAPONS DEMONSTRATION

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ARMY FIELD FORCES BOARD NO. 3
Fort Benning, Georgia

APPENDIX A - COPY OF DIRECTIVE

REPORT OF TEST - PROJECT NO. 2231

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DEPARTMENT OF THE ARMY
GENERAL STAFF, UNITED STATES ARMY
Washington 25, D. C.

19 October 1949

CSGLD/F5 51117

SUBJECT: Comparative Tests of Light Rifles and Ammunition

TO: Chief, Army Field Forces
Fort Monroe, Virginia
ATTN: Development Section

1. The inclosed agreements on comparative tests of small arms which were reached at conferences held in the Pentagon on 28 - 29 September and 14 October 1949 are approved.

2. The detailed plans of technical tests and user tests will be distributed separately.

3. It is desired that the Chief, Army Field Forces, take necessary action to complete the user tests in accordance with the agreements.

BY ORDER OF THE SECRETARY OF THE ARMY:

/s/ E. L. Cummings, Col., GSC
for /t/ C. G. HELMICK
Major General, GSC
Deputy Director for
Research and Development

1 Incl
Agreement, Lt Rifles and Am,
18 Oct 49 (10 cys)

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ATDEV-11 474(C)(19 Oct 49) 1st Ind
Subj: Comparative Tests of Light Rifles and Ammunition

Office, Chief, Army Field Forces, Fort Monroe, Virginia 20 April 1950

TO: President, Army Field Forces Board Nr. 3, Fort Benning, Georgia

1. Reference is made to:

a. Plan of User Test of New US and UK Rifles (to be conducted at Fort Benning) and to Appendices 1, 2 and 3 thereto.

b. Plan of User Test of New US and UK Rifle Ammunition, Phase I.

2. Ten (10) each of the T25 (US) Rifles, EM2 (British) Rifles and FN (Belgian - British) Rifles will be provided for the tests. Dates of arrival are not firm but it has been agreed that at least two (2) of each type will be available the first week, four (4) of each the second week, and all ten (10)the third week of the test.

3. The US rifles to be provided will all be equipped with in-line stock and chambered for the T65E2 round. As other rifles, chambored for the T65E3 round, may be provided at a later date, care must be exercised in order that the two (2) types rifles and cartridges will not become mixed. A directive for the second group will be provided by separate correspondence. Tests of the second group have no connection with tests under this directive.

4. To assist your Board in the conduct of tests one (1) Officer, Captain Lefevre, and ten (10) men will be provided by the Canadian Army. The ten (10) men will be as follows:

1 Sergeant (WO), section commander
3 Trained riflemen
3 Partially trained riflemen, and
3 Recruits who have just recently completed basic training.

5. Personnel from the United Kingdom will include Major Wilson, Captain Moore, a Mr. Frost (mechanic) and four (4) men. The officers, the mechanic and one of the four men will remain throughout the tests. The others will have to leave about 31 May 1950. Which of the above will be available as test personnel is not known.

6. Present plans call for discussion of the results of these tests at a joint US - UK Infantry - Airborne Conference to be held later this year at Fort Benning, Georgia. This conference is expected to convene in sufficient time to allow all conferees to complete their work and return home prior to Christmas. It is believed that the subject of rifles should, therefore, come up for discussion on or about 15 November 1950.

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ATDEV-11 474 (C)(19 Oct 49) 1st Ind (Cont'd)
Subj: Comparative Tests of Light Rifles and Ammunition

7. The demonstration of converted weapons, both US and UK, initially planned for Aberdeen will take place at Fort Benning at the conclusion of the user tests and presumably at the time of the above mentioned conference. A short report of the results of this demonstration will be required.

8. It is requested that your Board, in coordination with all interested agencies, conduct comparative tests of the subject rifles as outlined in the Plans of Test (reference paragraph 1 above) and be prepared to submit the results along with your recommendations as to suitability of any of the test items, rifles or ammunition, for Army Field Forces use.

a. The above report will be prepared in the normal form as for submission to this Office. Material covered in paragraph 7 above will be included as an Appendix to the report.

b. See paragraph c (3) of Inclosure Number 1 hereto for manner of preparation.

c. Details concerning submission to the Infantry-Airborne Conference will be issued later along with instructions as to number of copies.

FOR THE CHIEF, ARMY FIELD FORCES:

/s/ Neil M. Matzger
/t/ NEIL M. MATZGER
Lt Col, AGD
Asst Adj Gen

1 Incl
n/c (7 cys w/d)

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C O P Y

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ARMY FIELD FORCES BOARD NO. 3
Fort Benning, Georgia

APPENDIX B - CHARACTERISTICS SHEET

REPORT OF TEST - PROJECT NO. 2231

APPENDIX B

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APPENDIX "B"

Description of the Test Rifles and Ammunition Therefor

Part I. Rifles

I. Rifle, Cal. .280, EM-2:

1. General Description:

The EM-2 rifle is gas operated, air-cooled and magazine fed from a 20 round magazine. It can be fired semi-automatic or automatic with selective control by the firer.

The usual features of the rifle are the lack of a normal butt stock, location of the trigger forward of the chamber and an optical sight with no manual range adjustment.

The rifle is equipped with a rubber padded metal butt, a one-piece wooden hand guard and front stock called the front grip, and a pistol grip. The pistol grip is assembled to the trigger group at the rear of the trigger. The body at the rear end is coated with wood veneer to protect the firer's face from extreme high or low temperatures.

Recoil is taken up in a straight line with the bore and this minimizes any tendency of the muzzle to jump.

The butt is secured to the rear of the body by retaining lugs and a spring loaded catch. This enables the return spring, piston, breech block and cocking handle to be quickly and easily removed.

The trigger group can be removed from the body by withdrawing one fixing pin.

The sight is, in appearance, a small telescope but has no magnification. An inverted pointer and range graduations are incorporated in the sight and range variations are made by the selection of the required graticule.

The sight is housed within a protector. This protector and the sight bracket are used as a carrying handle.

2. Accessories:

These consist of Bipod, Grenade Launcher, Bayonet and Arctic Trigger assembly.

a. Bipod:

The bipod fits on an adapter which is affixed to the front end of the front grip, around the barrel. It can be folded under the weapon in either a forward or backward direction.

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b. Grenade Launcher.

The grenade launcher slides over the barrel and locks on the bayonet lugs. This method of fitting leaves a comparatively small space within the launcher, the remainder being taken up by the barrel.

The outside of the launcher is of conventional design with a folding sight fixed to the rear end of the body.

c. Bayonet.

This is of the knife blade type and has a handle. The bayonet is fitted to lugs on the barrel by rotating the rear portion of the handle through 180°, enabling it to slide over the barrel and lock into position.

d. Arctic Trigger Assembly.

This consists of an enlarged type trigger guard fitted with a trigger bar and safety lever attachment. This can replace the standard trigge guard and is secured by means of the trigger guard pin and the pistol grip screw.

3. General Operation:

a. In loading, a projection on the top front edge of the magazine is inserted and positioned in the magazine opening. The magazine is then pivoted to the rear around this point until it engages with the magazine catch.

b. Semi-automatic Fire.

A complete cycle initiated with the action open and the change stud on R (repeat) will be described.

On inserting a loaded magazine the breech block is released from the holding open device and, together with the piston, is driven forward by the return spring, which was compressed when the breech block was drawn to the rear. During the forward movement the breech block feeds a round from the magazine into the chamber.

When the trigger is pressed the rear end of the tripping lever rocks the sear lever up agazinst the front end of the sear in the breech block, depressing it and so releasing the firing pin. The firing pin is ther carried forward by its own spring and fires the round.

When the round is fired the bullet passes the gas port in the barrel; gas then passes through the gas regulator, enters the gas cylinder and drives the piston, together with the breech block, to the rear. During this backward movement the return spring is compressed. As the piston is engaged with the firing pin sleeve within the breech block, the firing pin is withdrawn until it becomes engaged with the sear. During this movement the

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firing pin cams the locking levers out of the locking recesses in the body. The piston and breech block are then together carried to the rear, extracting the fired case which is then ejected to the right and slightly forward.

At the end of the backward movement the piston is driven forward by the return spring. A stud on the underside of the piston, engages with the piston catch on the breech block and carries the breech block forward with it. During this movement the face of the breech block feeds a round from the magazine into the chamber, engaging the base of the round with the extractor. In the final forward movement of the breech block, the piston catch is forced down by a cam surface on the body, allowing the piston to continue its forward movement carrying with it the firing pin sleeve. This last movement of the firing pin sleeve forces the locking levers into the locked position and holds them there until the backward movement commences The action is now cocked ready to fire the next round and repeat the cycle.

When the last round in the magazine has been fired, a holding open device, incorporated with the magazine catch is operated by the loading slide in the magazine and prevents the breech block from moving forward. The magazine is removed by pressing the magazine catch forward and rotating the magazine downward and forward.

c. Trigger action.

With the change stud at R (repeat). When the trigger is pressed the tripping lever actuated by the trigger rocks the sear lever up and presses it against front end of the sear depressing it and so releasing the firing pin. In the initial backward movement of the breech block the tripping lever is cammed downward at the rear forcing the front end upward and out of engagement with the trigger. When the trigger is released it is forced forward by its own spring and into engagement with the tripping lever and held there by the tripping lever spring.

With the change stud at A (Auto) the tripping lever is forced down onto the flat of the pin by the tripping lever spring and is then out of position for contact with the breech block. As the trigger is pressed the tripping lever moves rearward and rocks the sear lever into contact with the sear.

In the backward movement the tripping lever is not disengaged with the trigger as in semi-automatic fire.

d. Automatic fire.

The cycle of events is identical to that of semi-automatic fire with the following exceptions:

As the tripping lever is not disengaged from the trigger as in Semi-automatic fire, the sear releases the firing pin before the breech block is fully forward or the firing pin sleeve has forced the locking levers into the locking recesses in the body.

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The breech block is moving forward, with the sleeve completing the locking action while the firing pin is moving forward to strike the primer of the chambered round.

The final forward movement of the firing pin cannot take place until the locking levers are in the locked position.

The rifle will continue to fire until the trigger is released, a stoppage occurs or all the ammunition in the magazine has been fired.

If the trigger is released before the magazine is empty the sear lever will be rocked out of position for contact with the sear.

II. Rifle, Cal. .280, FN:

1. General Description.

The FN rifle is gas operated, air-cooled, magazine fed from a 20 round magazine. It can be fired semi-automatic or automatic with selective control by the firer.

The rifle is equipped with a butt stock and handguard, also a pistol grip just in rear of the trigger guard. The butt stock assembles to the receiver at the conventional angle to the line of recoil.

The trigger and stock groups unlatch from the rear end of the receiver as a unit and pivot on the pin which secures it to the receiver.

The gas regulator in this weapon is designed on theexhaust principle and the escape of gas from the cylinder can be regulated by the selection of one of three vents in the gas regulator.

The cocking handle is independent of the recoiling parts and its use is limited to retracting the bolt.

The sights provided are a blade foresight, with protectors and an aperture rear sight. The rear sight is graduated from 100 yards to 600 yards in 100 yard stages. The required range is obtained by pressing a spring catch and sliding the sight up or down a ramp. On releasing the catch the sight locks in position. The line of sight is approximately 1.7 inches above the line of the bore.

Fired cases are ejected from the right side of the gun.

2. Accessories.

These normally consist of bipod, grenade launcher, and bayonet.

In addition to these, however, the following are available should they be required, stabilizer, flash hider and combination bayonet and flash hider.

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a. Bipod.

This is mounted on the barrel and is retained by lugs just forward of the handguard. The bipod legs latch in a closed position but do not fold under the weapon.

b. Grenade Launcher.

Of conventional design, with a sight which can be assembled to the rear end of the body.

Unlike the U.S. type grenade launcher the rings on the body are not used for range variation. The launcher is assembled to the barrel by a clamp fitting over the bayonet lugs.

c. Bayonet.

This is of knife blade type. It is fitted to lugs on the barrel. Has no handle.

3. General Operation.

a. In loading, the magazine is inserted in the magazine well and forced upward until the magazine catch engages on the notch on the rear wall of the magazine.

The magazine can be fitted with the bolt open or closed.

To fit the magazine with the bolt open the bolt must first be retracted by pulling the cocking handle to the rear and compressing the return spring. To retain the bolt in the open position the bolt stop must be operated manually. This is located on the left side of the receiver, immediately in rear of the magazine well. The cocking handle is then placed in the forward position and does not move during firing.

b. Semi-Automatic.

A complete cycle initiated with the action open, a loaded magazine in position and the change lever in the "Repeat" position.

To feed a round, the bolt is depressed releasing the bolt. The bolt is forced forward by the return spring and carries with it a round which is fed into the chamber. The claw type extractor rides over the base of the cartridge.

The rear end of the bolt is forced down by the bolt slide and is locked against a locking block in the receiver.

When the trigger is pressed the rear end of the sear is rotated upward causing the front end to go down and out of engagement with the hammer. The hammer, actuated by the hammer spring, rotates forward, strikes the firing pin and fires the round in the chamber.

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As the bullet passes through the bore, past the gas port, gas enters the cylinder and forces the piston to the rear. The piston bearing against the top front of the bolt slide forces it to the rear. The bolt slide cams the rear end of the bolt upwards unlocking it and the working parts then move to the rear.

In the rearward travel of the bolt the fired case is extracted and on contact with the ejector, which is an integral part of the receiver, it is ejected up and to the right. The bolt is grooved to provide clearance for the ejector. The bolt slide rotates the hammer back and downward for engagement with the sear.

The bolt and bolt slide are driven forward by the return spring which was compressed during the backward movement.

After the last round in the magazine has been fired an extension of the magazine platform actuates the bolt stop which retains the bolt in the rear position. The magazine is released by depressing the magazine catch which is located immediately in rear of the magazine well.

c. Trigger Action.

The sear is provided with a slotted hole, and since it is under spring tension from the rear, it is forced forward until the rear side of the sear slot bears against the sear pin. However, when it is in engagement with the hammer, which is under greater spring tension than the sear, the sear is forced to the rear and the hammer rotates upward until the front face of the sear slot bears against the sear pin.

When the trigger is pressed, the sear is forced upward at the rear and down at the front disengaging it from the hammer, the sear is then forced forward by the spring. After the round has been fired, the bolt slide recoiling with the bolt rotates the hammer until it engages with the hammer check. On the final forward movement of the bolt slide, the hammer is disengaged from the hammer check and rotates slightly upward until it becomes engaged with the sear.

If pressure is maintained on the trigger, the hammer cannot force the sear to the rear as the sear is held up by a shoulder of the trigger. The next round cannot be fired until the trigger is released so allowing the sear to complete its backward movement and override the shoulder of the trigger.

When the trigger is released the trigger plunger and spring return the trigger to its forward position and the weapon is then ready to repeat the cycle.

d. Automatic Fire.

A cycle initiated with the action open, a loaded magazine in place and the change lever in the A (Automatic) position will be described.

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Moving the change lever from R to A results in the sear being rotated further up at the rear, and the front out of position for engagement with the hammer.

A round is fed as for semi-automatic fire. When the trigger is pressed the hammer is disengaged from the sear and fires the round, the front of the sear being forced beyond the position where it can engage with the hammer.

After the first round is fired the cycle of events is the same as in semi-automatic fire with this exception: the hammer is engaged as before by the hammer check, the final forward movement of the bolt slide disengages the hammer check from the hammer and as the sear is inoperative the hammer can now rotate fully upward and fire the round.

The rifle will continue to fire until the trigger is released, a stoppage occurs, or all the ammunition in the magazine has been fired.

If the trigger is released before the magazine is empty the front end of the sear automatically rises into position for engagement with the hammer. As the action closes the hammer is automatically disengaged from the hammer check and engages with the sear.

III. Rifle, Caliber .30, T-25.

1. General description:

The T-25 is air-cooled, gas operated, magazine fed from a 20 round magazine. It can be fired both semi-automatic or automatic, with selective control by the firer.

The rifle is equipped with a stabilizer and an in-line stock to reduce the recoil and muzzle climb. A pistol grip is provided just in rear of the trigger. Both the stock and hand guard are of laminated wood.

The sights provided are a blade foresight with protective wings and an aperture rear sight, both of which fold down. The rear sight ranges from 200 yards to 800 yards; the elevation and windage adjustments are in one-minute-of-angle clicks. The line of sight is approximately 2.3 inches above the line of the bore.

2. Accessories:

These consist of the bipod, grenade launcher, and bayonet. Each of these must be mounted singly since each is fitted to the bayonet lug. The lug is an integral part of the stabilizer.

a. Bipod.

The bipod locks onto the bayonet stud and can be locked in two open positions, permitting an adjustment in height of the weapon for firing. In the closed position the bipod can be folded to the rear under the weapon.

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b. Grenade Launcher.

Of conventional design, the body is indexed with rings for range variation, with a spring at the forward end to retain the grenade in position.

c. Bayonet.

The U. S. Carbine bayonet was modified for adaption to the T-25 rifle.

The barrel band was enlarged to fit over the stabilizer and the handle was changed by providing a catch midway in the handle instead of at the rear end. It is assumed that the standard carbine bayonet-scabbard would be used.

3. General Operation:

a. In loading, the magazine containing 20 rounds is inserted into the magazine well and forced upwards until the magazine catch engages in the aperture provided in the upper part of the right hand magazine well. The magazine may be inserted with the bolt in the open or closed positions.

b. Semi-automatic Fire.

A complete cycle initiated with the action open, a loaded magazine in place and the selector in the repeat position will be described.

With movement of the trigger to rear the automatic sear is cammed downward to release the bolt, together with the operating slide, under the energy of the compressed operating spring. As the bolt moves forward it feeds a round from the magazine and clears the hammer, allowing it to rotate forward until it is engaged by the sear.

As pressure on the trigger is released the hammer disengages from the sear and moves into engagement with the secondary sear. The rifle is ready to fire.

A second pull of the trigger releases the hammer from the secondary sear; the hammer rotates forward actuated by the hammer spring. Energy is transferred from the hammer, through the rear and front firing pins, to fire the round.

On firing the round the bullet passes through the bore uncovering the gas port, allowing gas to enter the gas cylinder and hollow piston. The hollow piston moves to the rear, and gas from the bore is cut off.

In its rearward movement the piston drives back the operating slide with which it is in continuous contact. The operating slide cams down the boltlock for unlocking and the bolt moves to the rear. The fired cartridge case is extracted and when it clears the barrel, the ejector, which

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is continuously exerting pressure on the base of the cartridge, ejects the empty case upward through the action of the compressed ejector spring. The bolt rotates the hammer back and downward for engagement with the sear. The bolt is stopped on its rearward movement on contact with the fiber buffer located in the rear of the receiver.

As the bolt moves forward, actuated by the operating springs which were compressed in recoil, the hammer rotates upward until it is engaged by the sear.

If the trigger was released prior to this action, the hammer would be engaged by the secondary sear. In the forward movement of the bolt the top cartridge is stripped from the magazine and fed into the chamber. The weapon is now ready to repeat the cycle.

After the last round in the magazine has been fired an extension of the magazine platform holds the bolt in the rear position. Withdrawal of the empty magazine allows the bolt to move forward until it is engaged by the automatic sear which holds the recoiling parts to the rear until the trigger is pulled.

The magazine is removed by depressing the magazine catch located on the right side of the weapon.

c. Automatic Fire.

A complete cycle initiated with the action open, a loaded magazine in place, and the selector on the "Auto" position will be described.

Moving the selector from the "Repeat" to "Auto" positions result in the sear being forced back so that engagement with the hammer is not possible.

If sufficient pressure is then applied to the trigger, the automatic sear is disengaged from the bolt allowing the bolt and operating slide to go forward chambering a round as in semi-automatic fire. However, with the sear rendered inoperative, the hammer rotates upward until its movement is arrested by the hammer lock. In the final forward movement of the operating slide, after locking of the bolt has been accomplished, the hammer lock is disengaged from the hammer through a camming action of the operating slide.

The cycle in automatic fire is similar to that in semi-automatic fire except that, with the sear rendered inoperative and the trigger being held to the rear, the hammer continues to rotate until it contact the hammer lock. The rifle will continue to fire until the trigger is released, a stoppage occurs or all the ammunition in the magazine has been fired.

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If the trigger is released before the magazine is empty the action may stop in either the open or closed bolt positions depending on the point of the cycle at which the trigger is released. If the trigger is released during the forward travel of the bolt, after the bolt has passed over the automatic sear and before the hammer lock is tripped by the operating slide, the action will stop in the closed position with the hammer engaged by the secondary sear. Release of the trigger at any other point of the cycle will cause the bolt to stop in the open position.

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D. The physical characteristics of the rifles used in these tests are listed below.

Characteristics	T25	EM2	FN	M1
WEIGHTS (lbs)				
Rifle, basic *1	7.88	8.03	8.57	9.73
Sling *2	.50	.50	.50	.50
Bayonet, less scabbard	.62	.79	.67 *3	.96
Scabbard	.28	.33	.33	.28
Bipod	.80	.70	.57	———
Magazine, empty	.62	.54	.49	———
Magazine, full	1.66	1.45	1.40	———
200 Rounds, Ball	10.38	9.10	9.10	11.36
Grenade Launcher	.33	.66	.65	.63
Flash Hider	———	———	.09	———
Stabilizer	——— *4	———	.11	———
Rifle with loaded magazine and sling	10.04	9.98	10.47	
LENGTHS (Inches)				
Overall length	43	34-5/8	38-3/4 *6	43-1/2
Barrel	22	24-1/2	19	24
Overall with grenade launcher	45-1/2	36-1/4	43-1/4	47-1/2
Overall with bayonet fixed	50	42-3/4	47-1/4	53
Sight Radius	26-3/4	——— *7	22	28
TYPE OF FEED	20 Rd Mag.	20 Rd Mag.	20 Rd Mag.	8 Rd Clip
CYCLIC RATE OF FIRE	850 - 900	600 - 650	550 - 600	———
TRIGGER PULL (LBS) (AVERAGE)				
Semi. A.	7.9	11.6	10.75	6.0
Auto.	18.9			

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Characteristics	T25	EM2	FN	M1
POINT OF BALANCE				
With loaded Mag.	At front end of magazine opening	Slightly behind center of sight bracket	Above Mag. opening	At chamber
Without loaded Mag.	One inch forward of magazine opening	Slightly forward of center of sight bracket	Above mag. opening	At chamber
CALIBER	.30	.280	.280	.30
Cartridge	Ball, steel core, weighing 364 grains, Average powder charge of 46.6 grains. Average bullet weighs 136.8 grains. Additional types of ammunition include Tracer, Observing, API and AP.	Ball, mild steel core, weighing 322 grains. Average powder charge of 30.7 grains. Average bullet weighs 139.7 grains. Additional types of ammunition include Tracer, Observing, API and AP.	As for EM2	Ball, M-2 lead core, Wt. 396 grains. Average powder charge 50 grains. Average bullet weighs 152 grains Additional types of Ammo. Tracer, AP, API.
Type of Action	Air-cooled, gas-operated, magazine-fed light rifle. Selective automatic, semi-automatic.	As for T-25	As for T-25	Semi-auto. gas-operated clip-fed rifle.
Type of Stock	In-line	In-line	Conventional	Conventional
Type of Sight	Conventional block foresight and aperture back sight, each hinged so that they can be in a raised or lowered position. Graduated up to 800 yards. Adjustable to 1200 yards	Unit optical sight mounted on bracket which acts as carrying handle. Graduated for use up to 900 yards.	Low-lying conventional block foresight and aperture back sight. Adjustable up to 600 yards	Conventional block foresight and aperture back sight adjustable up to 1200 yards.
Number of Component Parts	128	133	103	66 (Drawing 44 div 24-2)

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*1 Average of 6.

*2 All lightweight rifles were provided with web slings which proved unsatisfactory and all tests were conducted with the standard M1 Rifle sling, the weight of which is quoted above. The web slings weighed approximately half the M1 Rifle sling.

*3 Bayonet and flash hider combination, less scabbard = .60

*4 Part of basic rifle.

*5 Loaded with 8 Rounds.

*7 Unit optical sight.

*6 FN overall length with stabilizer 40-1/4"

FN overall length with flash hider 41-1/4"

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Part II. Ammunition

E. Characteristics of Test Ammunition.

Six types of ammunition of each of the test calibers were submitted. These were:- Ball (in each case with a mild steel core), A.P., A.P.I., Tracer, Observing or Spotting and Grenade cartridges. The following tables show the characteristics of the various types. (General physical characteristics see paragraph "4 D Cartridge" above).

1. Velocity in f.p.s. recorded at 78'.

	-65°		-70°		-165°	
	.30	.280	.30	.280	.30	.280
Ball	2592	2164	2771	2237	2836	2361
A.P.	2606	2067	2822	2202	2835	2302
A.P.I.	2598	2017	2739	2196	2847	2308
Tracer	2554	2114	2629	2248	2732	2370
Observing	2510	2195	2726	2340	Not recorded	

2. Pressure recorded in lbs sq in.

	-65°		-70°		-165°	
	.30	.280	.30	.280	.30	.280
Ball	46515	38750	52050	43100	47715	45000
A.P.	48275	N.R.	51270	39200	48445	40000
A.P.I.	46205	N.R.	50390	39500	48495	40900
Tracer	43845	N.R.	42885	N.R.	40575	N.R.
Observing	38860	36200	42185	38500	Not recorded	

3. Overall length:- .30 2.785 inches
.280 2.54 inches

4. Component weights in grains.

	Bullet		Case		Charge		
	.30	.280	.30	.280	.30	.280	
Ball	136.83	139.63	180.35	150.72	46.57	30.57	
A.P.	136.08	128.45	180.51	150.59	46.55	29.55	
A.P.I.	137.52	130.24	180.11	150.84	45.79	29.44	
Tracer	134.12	115.17	179.95	151.16	39.65	25.51	
Observing	119.66	127.54	180.02	150.73	43.71	29.33	
						30.00	EM2
Grenade					41.00	31.5	FN

Each of the above weights is the mean of 10 rounds.

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